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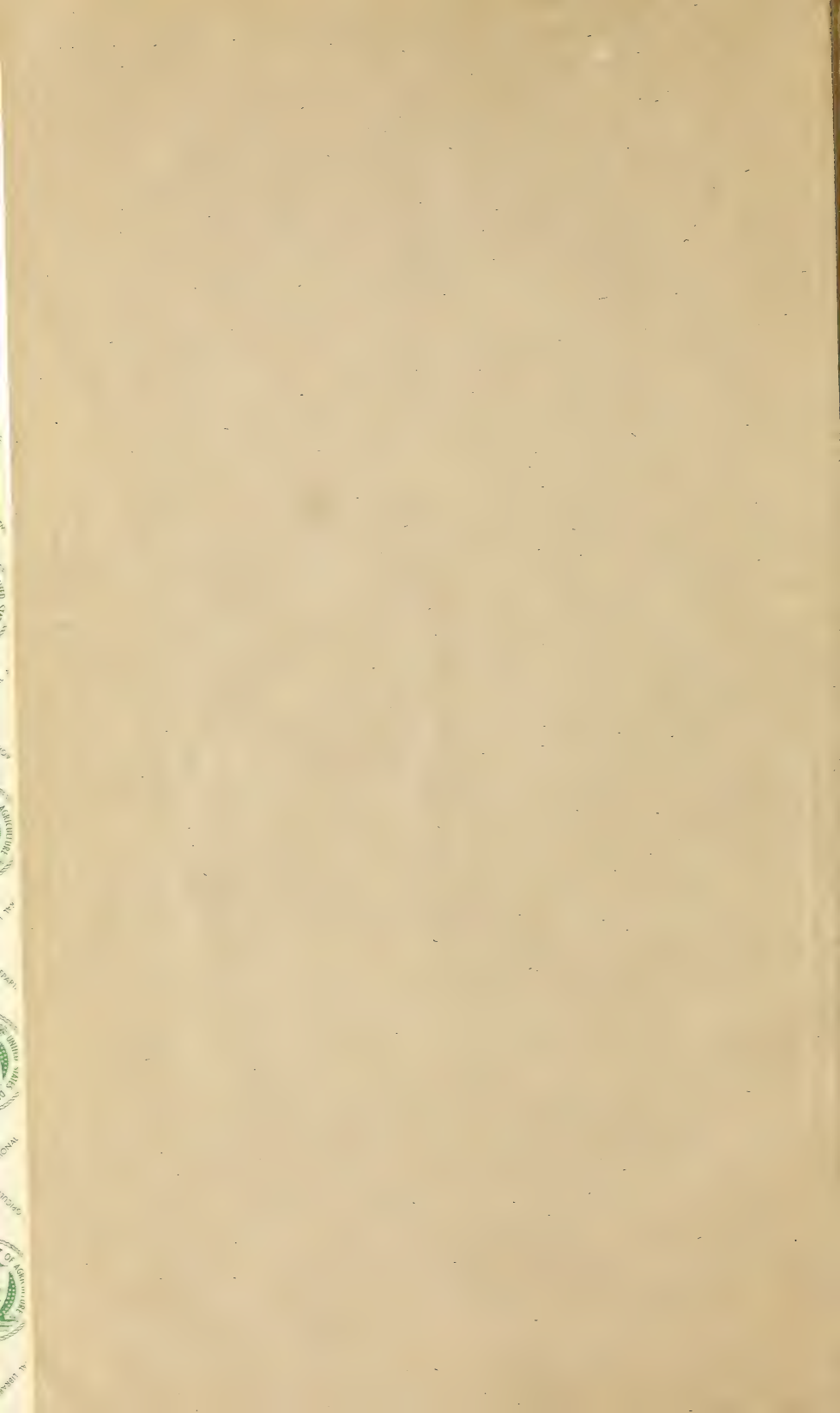
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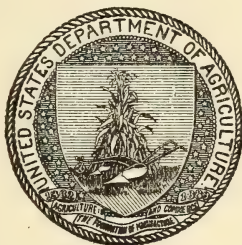
**REPORT OF
THE SECRETARY OF
AGRICULTURE - 1925**



REPORT
OF THE
SECRETARY OF AGRICULTURE



1925



WASHINGTON
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1925

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REPORT OF THE SECRETARY OF AGRICULTURE

WASHINGTON, D. C., *November 14, 1925.*

To the PRESIDENT:

I. THE YEAR IN AGRICULTURE

Improvement in the agricultural situation, which became marked in 1924, has continued in moderate degree during the present year. Farmers have not yet reached an economic parity with other great groups of producers, but their position is, on the whole, now the most favorable since 1920.

The heavy net movement of rural population away from farms has been checked. Noteworthy progress has been made in the liquidation of indebtedness among farmers. Purchase of supplies and materials for farm use has been resumed over the country on a scale contributing measurably to general business prosperity.

Agricultural production this year has on the whole been well balanced. The successive surpluses of cattle, corn, hogs, wheat, and various minor crops which so depressed the markets during and following 1920 have been largely worked off. Prices of farm products have in consequence risen to higher levels. The tendency this season has been even toward some expansion in production among certain major enterprises like cotton, corn, spring wheat, and sheep. Indications are that the acreage of winter wheat recently sown substantially exceeds that sown last fall. We have traveled around a fairly complete cycle in agricultural production since 1920.

Measured in terms of income, the economic position of agriculture as a whole promises to be at least equal to, if not slightly better than, that of the last year. Considerable improvement over previous years was manifested by the income from agricultural production for the crop year 1924-25, particularly in the areas selling wheat and hogs. Gross income from grains amounted to approximately \$1,900,000,000, compared with \$1,400,000,000 in the crop year 1923-24. Gross income from meat animals amounted to approximately \$2,600,000,000 compared with \$2,200,000,000 in 1923-24. Taking into account all farm production, the crop year 1924-25 represented an advance in total gross income from \$11,300,000,000 to \$12,100,000,000, or an increase of 7 per cent. These incomes are well above those earned during the depression, but below the earnings of normal years. It is quite likely that the reduction in the wheat crop this year may not be sufficiently compensated by higher wheat prices. The smaller volume of livestock marketings, however, may be more than offset by higher prices, even to the extent of covering the reduction in the return from grain crops. For agriculture as a whole, at best only a moderate increase in income may be expected for the crop year 1925-26 above the \$12,100,000,000 gross income of the past season.

Farmers are receiving better prices for their products than at any time in the past five years. The average of all farm prices for October was 143 per cent of the pre-war average as compared with 138 per cent in October, 1924. The real significance of this improvement in prices is better indicated by the relation of this change in prices of farm products to the changes in the wholesale prices of nonagricultural products. The purchasing power of the prices of farm products in terms of the prices of nonagricultural products has risen from 66, the lowest point of the depression period, to 87 in October, compared with the pre-war average of 100.

The current crop season has, as usual, shown some contrasts. In some sections there is distress. In others, crops are good and prices higher than at any time since 1920. In the great area from northern South Dakota to the Rio Grande and west to the Rockies, drought seriously reduced crop yields. The same is true in the area extending from the Ohio and Potomac Rivers southeast to central Georgia and east to the Atlantic. In certain restricted portions of these areas, the drought broke all records and farmers face the difficulties that follow when practically all crops fail.

Outside of the 15 States chiefly affected by drought, crop yields in 1925 were good, but they were not quite large enough fully to offset the reduction in the drought-stricken areas. Because of this, yields in the country as a whole were slightly below the average during the last 10 years.

For the growers of winter wheat this has been a season of disappointment. A fairly large acreage was planted, but the area killed by unfavorable weather conditions during the winter amounted to nearly 10,000,000 acres, or 22.5 per cent of the area sown. With the exception of 1917, this is the heaviest abandonment on record. As many of the fields left for harvest had thin stands and the crop also suffered from lack of moisture in the spring, the final harvest averaged only 12.7 bushels per acre, the lowest average yield since 1904.

Spring wheat looked very promising at first, but a correspondingly heavy yield was prevented by injury from rust, and the harvest was 13.3 bushels per acre. This is about 1 bushel per acre above the five-year average, but 2.6 bushels per acre below the splendid crop of 1924. In comparison with last year, however, the reduction in yield was offset by the large increase in the acreage planted in the Pacific northwest, where spring wheat was substituted for the winter wheat killed by the unusual cold.

Of all wheat, winter and spring varieties combined, the country harvested a total of 697,000,000 bushels, or 175,000,000 bushels less than in the preceding year. The crop was the smallest since 1917. In proportion to population it was the smallest wheat crop since 1890. Furthermore, of this year's crop nearly 67,000,000 bushels were durum, a variety which is rarely used for bread flours.

The corn crop of some 3,013,000,000 bushels was nearly one-fourth larger than that of the previous year and of much better quality, but was less than the average quantity harvested in the preceding four years. In the central portions of the Corn Belt and practically everywhere north of the Ohio and Potomac Rivers, an excellent crop was obtained, but corn was nearly a failure in the

Southwest, and the average yield was low in nearly the whole of the Cotton Belt and in some of the States along the western border of the Corn Belt.

A total of 1,470,000,000 bushels of oats and 227,000,000 bushels of barley were harvested, these totals being respectively 11 per cent and 25 per cent above the average production of the past five years.

The hay crop of 1925 was only 98,100,000 tons, the smallest since 1918. Allowing for 15,700,000 tons on hand May 1, 1925, and for probable holdings of, say, 9,000,000 tons next May (chiefly in sections where the 1925 crop was good), the quantity fed will probably be about 105,000,000 tons. A year ago the crop was 112,500,000 tons and the quantity used was close to 110,000,000 tons.

The cotton crop of 1925 is expected to be 15,386,000 bales and ranks with the crops of 1911 and 1914 as one of the three largest on record. No crop since 1914 has approached it in size. A record acreage and lack of excessive moisture during the growing season, with accompanying slight boll-weevil damage, were important factors in producing this crop. Good yields were obtained generally throughout the belt with the exception of south-central Texas and the Piedmont areas of the Carolinas and Georgia. The quality of the crop was materially lowered by weather damage during the latter part of the picking season. Prices generally are lower than a year ago, but for the belt as a whole, this year's income from cotton seems likely to equal that of last year.

The flaxseed crop of 22,300,000 bushels is much below the quantity harvested last year because of sharp reductions in both acreage and yield, but the crop was about 50 per cent greater than the average production of the preceding five years.

Buckwheat was a fairly good crop, and rice production was not far below average. Rye, sugar beets, and clover seed all gave low yields.

The potato crop of 346,500,000 bushels was the smallest since 1919, and in proportion to population it was even smaller than the crop of that year. Although the 1925 crop was 24 per cent less than that of the previous year and was of unusually poor quality, the quantity actually utilized for food may not be proportionately decreased because the 1924 crop was greatly in excess of domestic needs and many million bushels were fed to stock or used for starch or other low-value purposes. The shortage has, however, been sufficiently great to cause a substantial increase in the price of potatoes and probably some increase in the demand for substitute foods. The low production was owing partly to a reduction in acreage following several years of excessive production and low prices as well as to severe losses from freezing which occurred before all the crop was dug.

The sweet-potato crop amounted to only 81,100,000 bushels. A large acreage was planted but on account of drought the yield was only 80 bushels per acre. With the exception of last year the yield per acre was the lowest for 15 years or more and the production the lowest since 1916.

In the range States pastures and ranges are now very good, and the demand for both feeder and fat cattle has inspired greater confidence in the future. The prices of lambs and wool are relatively

high. In practically the whole area west of the Rocky Mountains crops have been good, and conditions are vastly better than they were a year ago.

Certain sections that suffered losses in previous years have this year enjoyed much needed profits. Some Maine potato growers are hoping to pay off fertilizer bills of several years' standing. Louisiana and Mississippi and some of the Gulf coast sections of Georgia and Alabama will make up part of their recent losses from the boll weevil.

Fruit and vegetable production was, in general, very moderate, chiefly because of drought and a reduced acreage planted to vegetables. Car-lot shipments of fruits and vegetables were about equal to the very heavy movement of the 1924 season, and apparently an unusually large proportion of the crops was successfully marketed. Prices were generally higher than in the preceding season through the greater part of the shipping movement, although for certain products there were periods of oversupply and depression.

Foreign demand for apples, the leading fresh-food export, has been active in each of the last two seasons, the movement showing double the volume of preceding years. For the producers of fruits and vegetables as a whole the year was more satisfactory in a financial way than any other recent season.

THE WHEAT SITUATION

The most significant fact about our wheat situation is that with a large world crop the United States apparently has little more than enough wheat to meet domestic requirements. The wheat crop of the Northern Hemisphere, outside of Russia and China, is estimated to be 11 per cent greater than the 1924 crop. It is larger than the pre-war average of production in the same countries, but not equal to the record crop of 1923. Russia is reported to have some wheat for export. Although it is not expected that Russia will contribute as much wheat for export as before the war, it is possible that she will export more wheat this year than she has exported in any other year since the war. Prospects are also good for the wheat crop in Argentina, but a short crop in Australia may offset the prospective increase in Argentina.

The world's supply of rye is also an important factor in the wheat situation. The rye crop, too, is much larger than last year. Estimates in the Northern Hemisphere outside of Russia amount to 981,000,000 bushels, as compared with 711,000,000 bushels last year. Russia is reported to have a good crop of rye. The effect of a good crop of rye in Russia is to encourage exports of wheat and the effect of good rye crops in Germany and Poland is to reduce the import demand for wheat.

The influence of this increase in production of wheat and rye as compared with last year is offset to some extent, however, by lower stocks at the beginning of the year and by the location of the increases in production. At the beginning of the year European stocks of old wheat were reported to be very low and the stocks in exporting countries as well as the quantity of wheat afloat were very much lower than at the beginning of last year. Most of the in-

creases in production of both wheat and rye are in Europe, where increased production will cause some increase in consumption. Latest estimates indicate that the total European crop of wheat outside of Russia and a few unimportant producers not yet reported is 323,000,000 bushels greater than last year and that the total European rye crop outside of Russia and a few small producers is 281,000,000 bushels greater than last year. Records of past years indicate very clearly that the European import requirements will not be reduced nearly so much as this increase in production. The fact remains, however, that the world's supplies for the year appear to be somewhat larger than last year in relation to the world's demand.

The situation in the United States is markedly different from what it was last year. The total production of wheat is but slightly greater than the quantity utilized in the United States last year. Out of an estimated production of 873,000,000 bushels last year, the balance of exports amounted to 252,000,000 bushels, leaving 621,000,000 bushels in the United States. In addition to this balance about 44,000,000 bushels were drawn from stocks, indicating a total utilization in this country of approximately 665,000,000 bushels. Should the same quantity be utilized in the country this year, there would be only about 32,000,000 bushels of wheat for export without further reduction of stocks.

Considering the production of the various classes of wheat and the other conditions that affect the marketing of our wheat, it is apparent that we shall export, and we are exporting some wheat. More durum wheat has been produced than is needed in the country. There is also some wheat on the Pacific coast for export or for shipment to eastern States. It appears, on the other hand, that not enough good hard red winter and soft red winter wheats have been produced to meet the usual mill, feed, and seed requirements of these wheats. The mill demand for these wheats, as well as for the hard red spring wheat, is in part for flour exports. It seems, therefore, that we may export durum wheat, some of the soft wheat from the Pacific coast, and about the usual quantity of flour. There may be some exportation of other wheats in the beginning of the season which will have to be offset later by imports.

The shortage in supplies of several classes of wheat may place the United States on an import basis at least for a greater part of the year. The surplus of durum wheat will have to meet competition of wheat from North Africa and Russia in Mediterranean markets, and the price of that wheat has already fallen as low as \$1 per bushel in sections of North Dakota in the middle of August. The prices of other wheats are now too high compared with world markets to permit of exports on the basis of these prices. The prices of wheat for December delivery in Chicago, Minneapolis, and Kansas City are nearly on a par with the price in Liverpool and considerably higher than in Winnipeg. Canada is the nearest source of imports. Both the futures and cash prices for wheat delivered at Port Arthur are now considerably below prices in Chicago and Minneapolis. A small quantity of wheat has been imported, but the margin is not yet sufficient to encourage heavy imports, duty paid. It is probable, however, that as high-grade milling wheat becomes scarcer in the

United States, the price margins will widen. Canada has a large supply of hard red spring wheat and a small quantity of soft red winter wheat, so that the relation of prices in the United States to the world-market level may be worked out through the relation of Canada to the world-market level, plus approximately the tariff duty.

Farmers received for their wheat at the beginning of the season prices considerably higher than those of last year. Last year, however, on account of a small world crop, prices moved rapidly upward from the beginning of the season until February. We are facing a different situation this year in that the world crop is much larger. In many parts of the country the higher prices thus far received are not sufficient to offset the reduction in the crop yield, so that farmers may not receive as great a return from this year's crop as they received from last year's.

Looking ahead, according to the "intentions-to-plant" report, high prices have encouraged farmers to consider increasing the wheat acreage of the United States. In planning wheat production the situation both in the United States and in the whole world should be considered. Even with the same acreage as last year, a good average yield would place the United States on an export basis for most if not all classes of wheat. The trend of production in many countries that compete with the United States is upward. Production in European countries affected by the war is rapidly approaching pre-war status. Russia, a large exporter before the war, is recovering. The wheat-producing areas of Argentina, Australia, and Canada are now 53 per cent above pre-war average, and these countries have not yet reached their limit. Under these conditions, only poor crops in important foreign wheat-producing countries can result in a situation comparable to that of last year, when the farmers of the United States had a good crop which they sold at high prices.

THE COTTON SITUATION

The 12 months ended July 31, 1925, brought to the world perhaps the best balance between cotton supplies and consumption since the outbreak of the war. Cash proceeds were well distributed throughout the Cotton Belt. The prospect is for a 1925 crop materially larger than that of 1924. Indications are that the grade of the crop will probably be very much lower, and that the cash proceeds, owing to sectional damage caused by drought, will be less generally distributed than in 1924.

From a production standpoint, the results of the 1924 crop were so encouraging that in the spring of 1925 more than 46 million acres were planted to cotton. This was the largest acreage in the history of the country. The increase was greatest in the extreme western part of the Cotton Belt, where large areas of range land have been broken up and devoted to cotton cultivation, and where drought prevented the seeding of the usual acreage of grains. Although growing conditions have been less uniformly good than in the previous year—drought having brought disaster to certain sections of the Southeast and Southwest—they have been extraordinarily

favorable in many sections and the third largest crop in the country's history is expected. The department's forecast on November 9, 1925, was approximately 15,386,000 bales.

At present prices this production would represent a total value about equal to that of 1924. Drought and generally dry weather caused early opening of bolls in many sections, and early rains have lowered the grade of much of the crop. This condition has been somewhat accentuated by a scarcity of picking labor in certain localities, because of which some cotton has remained exposed in the field.

The large crops of 1924 and 1925 have done much to allay fear that the boll weevil and other checks have curtailed the ability of this country again to produce an adequate supply of cotton. Occasional suggestions that it may produce a series of crops large enough to depress prices below the point of profit are tempered by a realization that the use of cotton in industry is increasing, that the world appears to be regaining its pre-war capacity to consume cotton and that in the present and preceding seasons weevil depredations have been unusually light. Our production of cotton is still somewhat less than it would have been had it followed the trend of the 30 years preceding the World War.

The increased crops of 1924 and 1925 have been coincident with increased cotton-consuming power in Europe, following stabilization of currencies and credit conditions. This improvement was shown in exports from the 1924 crop more than a third larger than the average of the preceding five years. Exports for the first months of the 1925 season were even larger than in 1924, though this may have been owing in part to the earliness of the season.

Domestic business conditions also showed improvement, being supported by general improvement in domestic agricultural conditions. Domestic mill consumption sharply increased toward the latter part of the season, and seems to promise a good domestic demand for the 1925 crop.

Satisfaction was expressed by manufacturers over the relief they obtained by the 1924 crop from an acute shortage of raw material, although world consumption of American cotton for the crop year was only about half a million bales less than the production. Stocks in this country, moreover, were only about 100,000 bales larger on July 31, 1925, than a year before, and this quantity at current rates of domestic consumption meant a difference of less than a week's requirements of our mills. With a crop of $15\frac{1}{3}$ million bales in 1925, it is possible that there may be some further restoration of stocks which as yet are considerably below pre-war quantities.

The anticipation of a crop in 1925 larger than the crop of 1924, together with the slight increase in supplies at the beginning of the season, has been naturally accompanied by somewhat lower prices. The average price for the 1924-25 season in 10 designated spot markets was 24.22 cents a pound. This price represented a reduction of 5 or 6 cents, or about 20 per cent from that of the preceding season. On the other hand, the purchasing power of cotton in terms of all other commodities was calculated for August, 1925, at 116 per cent of the average purchasing power in the five years

preceding August, 1914. Although this represents a reduction over the immediately preceding years, it is nevertheless a price that compares favorably with that of other crops grown in the South.

It should be noted, however, that production outside the United States has increased rapidly in the last two seasons, as a result, no doubt, of the stimulus of favorable economic and weather conditions rather than of concerted effort, though there has been much of the latter. A further increase of foreign production will bear careful study, since it may lead to a competitive situation in which the advantage will rest with the producer whose costs of production are lowest or who produces cotton of a quality most in demand. Under such conditions, the shorter staples grown in this country would probably feel the competition of cotton grown with cheap labor in India, China, and elsewhere.

The department is giving close attention to the possible competition which foreign cotton production may force upon our short staples. It is particularly concerned with cotton breeding and testing, so that a more general production of prolific cotton of high spinning quality may be facilitated. Studies have been made of production costs in 15 counties typical of as many distinctive areas in the Cotton Belt. Scientific investigation has been made of the less obvious properties of cotton fibers which contribute to their spinning value. The results of this work have been made available to breeders of seed and to other cotton growers. Spinning tests are being carried on to determine the relative waste content and the strength and evenness of yarns from cottons of various varieties, and from cottons of the same varieties grown under various conditions of soil and climate. Tests of the same sort have been made of cottons of different grades. These tests have demonstrated the relative superiority of higher grades over lower grades, from the standpoint of waste percentages and values, yarn strength and evenness, bleaching, finishing, and mercerization properties, and efficiency of machine operation.

Concurrently the work of quality standardization has been carried forward. New agreements have been negotiated with foreign markets within the year, which assure the use of the grade standards throughout the world, thus solidifying their establishment and adding to their usefulness in our own country. The staple standards have also been reviewed in the light of past experience and certain slight modifications projected in the physical representations, all of which are calculated to make them more workable and dependable as measures of length. There are few problems of an economic nature, either in cotton production or distribution, to which fixed and accepted standards of quality are not fundamental.

THE LIVESTOCK OUTLOOK

Livestock producers found themselves in a rather more favorable position this year. Hogs averaged more than 60 per cent higher in price during the first half of 1925 than in 1924. At times they brought nearly double the 1924 price. Top-finished and heavy-weight cattle sold up to \$16.35 per hundred pounds at Chicago. This was the highest price registered since 1920. The average price for

lambs in August was \$1.50 higher than in 1924. It was the highest for that month in six years; and three-eighths blood wool averaged more than 50 cents a pound. Lessened supplies were partly responsible for the advance in hog prices. The short corn crop of last year, however, compelled the feeding of relatively expensive grain, so that producers did not obtain an increased net income proportionate to the increase in hog prices. The supplies were not reduced relatively so much as the prices increased, and during a part of the year a decrease in the number of hogs marketed was offset to some extent by an increase in average weights.

Marketings of cattle, calves, and sheep were heavier during the first half of 1925 than in the corresponding period of 1924. Indications are that the total quantity of meat produced in 1925 will be nearly as great as in 1924, and the gross returns from its sale the highest since the speculative period of 1919.

One of the important developments of this year has been an advance in cattle prices. A gradual improvement has been shown in the cattle market since December, 1921, but at times this improvement was so slow as to be almost imperceptible. It took the rapid improvement of 1925 to convince cattlemen that the tide had definitely turned.

In parts of the range country there has been a marked tendency toward lower production. Some cattlemen have gone out of the business. Others are keeping fewer but better cattle. There is, however, no beef shortage as yet, although heavy runs of cattle and calves are tending to reduce basic supplies. Receipts of cattle and calves at public markets during August, 1925, were the heaviest on record for that month. Prices advanced in spite of increased marketing. Receipts at central markets have been increased by contributions from the dairy industry, which every year is supplying a larger proportion of our beef and veal.

Although top cattle prices at Chicago in August were \$2 higher than they were a year previously, the average of range-steer prices for the same month showed advances of only about \$1. Stocker and feeder prices in August were only 70 cents higher than in August, 1924. These facts may somewhat temper enthusiasm over the upturn in the cattle market. Higher fat-cattle prices, however, always stimulate the demand for feeders, and a good demand for feeders reacts favorably on the market for range cattle. It would seem, therefore, that eventually all branches of the cattle industry should feel the benefit of the better price situation.

Reduced hog marketing is helping the cattlemen materially. They have also been benefited by good forage conditions over most of the range country, although some sections have had severe drought.

Sharp curtailment of hog production resulted from the unfavorable relationship which existed between hog prices and corn prices in 1924. Fewer sows were bred in spite of a sharp upturn in hog prices last fall. As a result market receipts of hogs in August this year were 20 per cent less than in August, 1924. They were 15.6 per cent below the five-year August average. In the first eight months of 1925 hog receipts dropped 19 per cent from the total of the corresponding period in the previous year. Moreover, the average weight of hogs marketed in the early part of 1925 was below

normal. Later, however, advancing prices presumably influenced growers to market fewer hogs.

There is now a marked tendency toward feeding to heavier weights. If this continues, the reduction in pork produced will be much less than the decrease in the number of hogs. Although hog prices broke sharply in August, they were still considerably higher in September than in the same month of 1924. Our foreign trade in pork products, although less than during the peak war years, was fairly satisfactory. Altogether, the hog situation in 1925 was one of improvement.

For the last two years the sheep industry has been perhaps the brightest spot in the livestock situation. Sheepmen will close their books this year with a very favorable showing. This prosperity has naturally drawn to it many new producers, including some inexperienced sheep raisers. Sheepmen should bear in mind the tendency of their business to go from one extreme of production to the other and should guard against overexpansion.

The average price of lambs in August was \$1.60 higher than in the same month of 1924. For the first eight months of the current year the average price of lambs showed a net advance of \$1.13 over 1924. As a matter of fact, during the past two years lambs have sold at nearly double the pre-war price. They have almost equaled the average prices that ruled during and immediately after the war. Attention to scientific methods of production, and prudence in expanding the number of sheep on farms and ranches, should help to maintain the sheep industry in its present prosperous condition.

The efforts of the department to work out a standard system for classifying and grading both live animals and meat have found favor among representative stockmen and dealers. This is one important move in the direction of greater marketing efficiency.

The department has worked out a schedule of standards for meat covering beef, veal, lamb, mutton, and pork, which have been accepted to a gratifying extent by the wholesale and retail meat trade, and by the consuming public. It has also established a meat-grading service.

WOOL

A 5 per cent increase in wool production and a million more sheep on farms in 1925 than in 1924 are proof of returning confidence in the wool-growing industry of the United States. The favorable position of the industry at the present time is likely to encourage further expansion during the coming year. Wool growers generally were seriously affected by the postwar depression of 1920 and 1921, but the relatively good prices obtaining during the years 1923, 1924, and 1925 have enabled them for the most part to recover or to complete the readjustments the depression necessitated.

The fall and winter of 1924 saw a remarkable rise in wool values, but wool growers, with the exception of those marketing their clip late in the season, benefited little at the time. The advance, however, did create a keen demand for the 1925 clip, and contracting for the wool at high prices was carried on with vigor and energy from six to eight months prior to shearing. Wool values declined rapidly in the early part of 1925, reaching their low point in May.

Nevertheless, the wool-growing industry of the United States should continue for some time on the substantial basis it now occupies, although fluctuations in prices during the coming year are not unlikely.

DAIRYING

The dairy situation is more favorable than it was a year ago. Production is less than last year, consumptive demand has been good, and the storing season closed without burdensome surpluses. Prices of all dairy products are higher and have followed a more normal trend.

Production in 1924 was heavy. It was stimulated by ideal weather and by some increase in the number of cows. Production in 1925 will be less. Prices are higher. On September 1, 1924, the normal peak date for storage holdings, butter stocks were at a record high mark. These stocks were cleared before the 1925 producing season began, yet they exerted a depressing influence throughout the fall and winter. September 1 this year found stocks on hand more nearly in line with prospective requirements. Fall production did not seem likely to be unusually large. The position, in short, was statistically more favorable to producers.

The foreign situation has strengthened domestic markets. Except for exports of condensed and evaporated milk, outlets for domestic production of dairy products are very largely confined to our own markets. There is always the possibility, however, of our domestic supply being supplemented by imports from Denmark and from countries in the Southern Hemisphere, which are forging ahead rapidly as sources of supply. The European demand has been sufficient this year to hold prices in European markets at levels which, together with our own tariff barrier, have prevented imports of any consequence.

POULTRY

From the producers' viewpoint the egg situation this year has been fairly satisfactory. Apparently production has been about the same as last year, whereas egg prices, stimulated by the previous profitable storage season, were considerably higher during the spring and summer than a year ago and have continued higher as far as fresh eggs are concerned. Storage-egg prices, however, because of larger accumulations in the warehouses and an unsatisfactory movement during the early fall, are lower.

The widespread disease situation last fall and winter, with its attendant embargoes on shipments of live poultry, had a most disturbing effect on the poultry industry. Consumption was restricted and stocks of poultry in storage piled up to such an extent that the disposal of a considerable proportion at a profit was impossible. Poultry prices to producers have been fairly well maintained, however, and with consumption and storage stocks at a more normal level, the situation is considerably improved. There appears to be about a normal supply of poultry on farms this year.

FOREIGN MARKET SITUATION

Our agricultural exports for the year ended June 30, 1925, were 21 per cent greater in volume than in the previous year and 26 per cent greater than the average for the five years just preceding the

outbreak of the World War. The value of these exports was more than double the value of the agricultural exports of any pre-war year and greater than that of any year since 1921.

The increased demand was due in part to smaller crops, in part to increased purchasing power in foreign countries. A shortage in European wheat crops greatly increased the demand for overseas wheat. A shortage in the Canadian crop left the European market largely to us. Accordingly we were able to sell in the year ending June 30, 1925, more than 169,000,000 bushels of wheat, including flour, in Europe at prices considerably higher than the prices obtained for a much smaller quantity (69,000,000 bushels of wheat, including flour) the previous year.

On the other hand, exports of pork and lard fell below the previous year's figure. This decline was owing mainly to decreased production in the United States and increased production in Europe. Substitution of other products, such as Argentine beef for pork, and butter for lard, had also something to do with it.

The European market for Argentine beef has been strong. This has lessened the probability of Argentine shipments to the United States—an obvious benefit to our own beef-cattle industry. In like manner our domestic markets have been almost freed from foreign butter, chiefly as a result of increased exports of Danish butter to Germany. Our net imports of dairy products in the last year were the smallest in several years.

Foreign competition continues to grow stronger in some lines of farm production. The wheat area of Canada has increased from a pre-war average of 10,000,000 acres to 22,000,000 acres in 1925. There are still large areas in Canada suitable for wheat production. Australian wheat area has increased from a pre-war average of 7,600,000 acres to 10,800,000. Argentina reports having sown a record acreage. The wheat area of these three countries together is now about 53 per cent above the pre-war average. Dairy production continues to expand in the Southern Hemisphere. New Zealand and Australia have just finished a season of record output. The production of these two countries has expanded greatly since the war. They still have room for expansion. Argentine dairy production has also increased considerably since the war. The further development of the western Provinces of Canada and the recovery of Europe are adding to the world's supply. Siberia, a large exporter of dairy products before the war, is also recovering.

It is well to note that increased purchasing power in European countries may not always result in an increase in the demand for American farm commodities. As European agriculture recovers there will be a tendency for European countries to reduce imports of the crops that they produce. The larger crops of grain harvested in Europe this year will undoubtedly have this effect. The European market for cotton, however, will probably be maintained as long as business conditions in Europe remain good.

Our agricultural production this year will probably not provide for the year a volume of exports so large as that of last year. Of wheat, one of our most important items for export, we have at most only a small quantity in excess of our domestic requirements. Present indications are that the cotton crop will furnish for export more

than last year. The number of hogs has been so much reduced that the pork and lard exports are likely to remain low. Of some other products, such as tobacco, apples, and many minor items, we may continue to export about the same quantity as last year. It should not be overlooked, however, that the trend of exports of many of our products for the last 15 years before the war was downward. This was owing largely to the fact that our industrial population was increasing more rapidly than the production of many of our agricultural products. A reduction in our agricultural exports would therefore be in line with pre-war tendencies.

FARM CREDIT SITUATION

Good crops and increased prices have materially improved the financial position of our farmers. In some regions, particularly in the Corn Belt, where commitments for high-priced land and farm improvements reached heavy proportions, and in the cattle country, where livestock growers suffered almost unbelievable losses, large numbers are still confronted with financial problems, the solution of which will tax their best efforts.

Substantial progress has been made in improving the rural-credit situation through legislation setting up machinery for both short and long time credit. Much remains to be done, however, to make the new agencies effective; they must be brought to the farmer so that he can avail himself of their facilities. Particularly is this true of the intermediate credit bank system, its rediscounting privileges having been utilized, in most areas, only to a limited extent. The intermediate credit banks have assumed a very important rôle in financing cooperative marketing organizations, and there is every reason to believe that they may fill just as important a place in financing the individual farmer where local capital is inadequate.

There are many regions where the small farmer, particularly, is at a disadvantage. He is compelled to pay high interest rates for short-time loans, to which additional commissions are frequently added. Crop liens and chattel mortgages often interfere with the marketing of his products to best advantage. This is a situation which also affects the development of cooperative marketing. The organization of local agricultural-credit corporations to make available additional credit through the rediscounting facilities of the intermediate credit bank system, should materially improve these conditions. Where local banking facilities are adequate, the organization of new rediscount corporations should not be encouraged, as the new intermediate credit system was intended to supplement rather than compete with existing banking machinery.

The depression revealed weaknesses in our agricultural credit facilities which intensified the difficulties of farmers and stockmen. As agricultural conditions have improved, the credit problem has become less pressing. A sound credit structure, however, is no less important now than in the past. We should, therefore, devote ourselves to repairing and putting in shape our agricultural credit machinery so that it may be in a position to carry farmers through agricultural depressions that may come in the future.

It should be borne in mind, also, that in many regions a lack of confidence in agriculture has retarded expansion and farm improve-

ments. Farmers under these conditions have been devoting themselves to the liquidation of existing indebtedness rather than seeking additional loans. This, naturally, has led to a smaller demand for credit. With a renewal of confidence in farming conditions it is likely that weaknesses in local credit facilities will become apparent.

The credit situation in certain areas has been seriously complicated as the result of numerous bank failures. Impaired confidence in the banking situation and in the stability of agriculture has caused banks to maintain extremely high cash reserves and has resulted in a shift of banking funds from agricultural investments to Government and industrial securities. This is illustrated by the fact that in some rural communities the percentage of deposits represented by cash or Government obligations reaches 75 to 80 per cent of the total deposits. When confidence is again restored in these regions a more stable credit situation will follow.

II. ECONOMIC PROBLEMS OF AGRICULTURE

AGRICULTURAL SURPLUSES

Agriculture can not make its adjustments in production to demand as rapidly and accurately as can industry. It is handicapped by weather conditions, by animal and plant pests, by limitations of soil and climate, by fixed periods of growth, by slow turnover, and by other more or less uncontrollable influences. A great deal has been done and can be done toward adjusting production to anticipated market requirements. Nevertheless, surpluses of agricultural commodities will be produced from time to time, no matter how prudently farm crops and livestock may be regulated in accordance with forecasts of supply and demand. Nature will give us bountiful yields in some years, even though acreage may have been cut down. In short, nature may upset the best-considered plans for establishing a harmonious balance between production and consumption.

What can be done toward handling unavoidable surpluses, which are so disastrous to a stabilized agriculture, when they occur unavoidably? This is one of the major economic problems of the Nation. It is well known that small surpluses exercise a depressing effect on prices altogether disproportionate to their amount. Measures to regulate the movement of surpluses into consumption so that unnecessary price fluctuations can be avoided and speculative hazards lessened are urgently needed.

It is to the interest of the entire community that agriculture should not be periodically depressed by overproduction and low prices. Business, indeed, has almost an equal interest with agriculture in preventing undue fluctuations in farm commodity prices. Whatever benefit low farm-commodity prices may temporarily seem to bestow on the consumer are eventually offset by a movement the other way. Stabilized production and marketing of agricultural products are clearly in the public interest.

Perhaps an analysis of the surplus problem will help us to decide what the nature and the principles underlying these measures should be. In the first place, we should clearly recognize what the surplus is. It may be a useful and necessary carry over from one producing season to another, part of which is involved in the process of manu-

facture and distribution and part of which is the national reserve against fluctuating seasonal production. It may be overproduction beyond the domestic and world demand. From a purely practical point of view there is the possibility of developing marketing methods which will prevent the carry over from depressing prices to unfair levels.

In the field of production there is one important thing that Government agencies can do. They can furnish farmers with a background of economic information which will serve to guide intelligent programs of production. The Department of Agriculture is already undertaking to collect and disseminate accurate information on production, movement, prices, and consumption of farm products.

The department's work along these lines is being rounded out to a comprehensive service. It compiles and disseminates the data on intended plantings of both spring and fall crops. It makes careful pig surveys, indicating farrowings and the pig crops in expectation. It is beginning similar calf surveys and will shortly cover the whole livestock industry. It issues timely statements on the outlook for production in each of the important lines. This is not an academic service. It is a real stabilizing force. The department has been forecasting the corn-hog situation accurately for a considerable period. Those swine producers who heeded its warnings in the spring of 1923 and its encouragement in the fall of 1924 have made money both ways by doing so. Those potato producers who heeded its advice not to reduce acreage too much last spring have profited thereby. Next summer will come the danger again of too great a potato acreage. The wheat situation would give promise of greater stability next year if there were more general adherence to the cautions clearly sounded in this fall's outlook. In stabilized production and in avoidance of wide swings lies the greatest assurance of profitable adjustment to the markets.

The Department of Agriculture is vigorously developing this service of supplying farmers with basic information by which orderly production may be guided. Through its Extension Service and in cooperation with State agricultural departments and colleges of agriculture it is perfecting and localizing the machinery of dissemination. In time this program will contribute measurably to reduce the fluctuations of unbalanced production.

In the field of distribution, public agencies should—as they already do—help the surplus problem at many points. In this field, again, the Government can provide essential background information as a guide to orderly marketing. The Department of Agriculture's forecasts and estimates of crop and livestock production are already the accepted data of trade. Its market news service covers the movements and prices of every important farm product.

A comprehensive system of standards of grades for farm products should be set up. The Department of Agriculture has made considerable progress on this project. It has already secured establishment of standards and grades for a number of major crops. Its cotton standards are accepted in the world's markets. Such action reduces hazard in marketing and diminishes the margin between the farmer and the consumer.

Warehouses and terminal storage facilities should be made adequate and stored farm products given a credit status on a par with other commodities. The act permitting Federal licensing of warehouses illustrates what can be done. Cold storage and merchandising dependent thereon can be developed beyond present limits.

Many developments will be possible in the credit structure. The system of intermediate credit is a case in point. The intermediate-credit machinery, one of the greatest accomplishments for agriculture, still needs extension, however, to fit the needs of various perishable crops. Some phase of our credit machinery must be evolved that will permit much broader storage of nonperishable crops.

There are therefore manifestly two general avenues of approach to the surplus problem. One is through better management of production, and the other through marketing and distribution. In the latter field we have three major issues, the problems of storage of a given harvest pending consumption during the year or season, and the problem of storage for the carry-over. We have in all storage questions immediately the problem of credit. Beyond these two questions of storage and credit we have the third problem, and that is orderly control of the stream of supplies to the consumer. We can solve the first two of these issues by better provision of facilities, but we can only solve the third by collective action.

It should be stated, also, that the provision of storage and credit must be differentiated as to application in the different kinds of products. In order to approach the problem from a practical standpoint it is essential to distinguish between the situations which arise in the three great groups of perishable products, nonperishable products, and livestock. This it will be noted is a purely arbitrary grouping.

While there is a great deal that can be done in adjustment of production in perishables such as fruits, vegetables, and dairy products, there also is the enlarged opportunity of restricting the flow of current products into the market by better standards and grades and by the diversion of the surplus, which then will be composed largely of inferior qualities, into by-products. All this implies organization, which already has made great headway in these commodities. There is also the possibility of broadening consumption of certain foods with benefit to all concerned.

Similarly in the case of nonperishables, like grain and cotton, something can be done in the field of better organized production and in the provision of enlarged storage and credit facilities.

As for the third general group—livestock—the major emphasis should be on the production end, although something can be done in the distribution field. It is frequently impossible to gauge the situation perhaps years in advance, and in such cases the distributive machinery may be made to function more effectively than at present. While better direction of production offers definite possibilities in both perishable and nonperishable groups, it offers the most effective solution in the livestock problem.

In the problem of control of the stream of products to the consumer we enter upon our most difficult field, a field which, as I have said, requires collective action. I believe farmers through their organizations have a most powerful instrument to control the move-

ment of surpluses into consumptive channels. In my judgment the activities of Government agencies in connection with the surplus problem should supplement and assist rather than control and direct the efforts of the farmers themselves and their associations. To accomplish this may call for enabling legislation. It should be borne in mind, however, that any plan built around cooperative associations should be based upon the ability of the existing and potential cooperative associations to handle surplus crops. Otherwise their initiative and usefulness might be seriously impaired or destroyed.

It seems to me that there is plenty of room for action here without injuring the rights of the consumer by any development of trading practices in restraint of trade. Farm production is so extensive and varied, so dependent on nature, that restriction of it to the point at which the consumer's interests would be menaced is a remote possibility.

A measure of the progress already achieved in this direction is the fact, mentioned elsewhere in this report, that nearly one-fifth of our agricultural business, or \$2,500,000,000 worth, was done this year through farmers' business organizations.

Even if direct Government interference in the channels of trade were to be tolerated by the consuming public, it would, in my judgment, lead to heavier production and ultimately an aggravation of the whole problem. Government buying and selling, if successful, would smother the cooperative movement because it would eliminate the incentive for collective action. It does seem essential, however, that this issue should receive broad recognition as a problem of national importance and, second, that public agencies should make every proper effort to cooperate in sound workable programs looking to its solution. The discussion of the problem of surpluses is entering more and more upon common ground, and I look forward to an agreement upon the principles of a solution along the broad lines here suggested.

AGRICULTURAL COOPERATION

The most distinct and significant movement in American agriculture in this decade is the almost universal trend toward cooperation in the marketing and distribution of farm products. It is in no sense a regional or sectional movement, for it exists in all sections and is participated in to some extent by producers of practically all kinds of farm products.

There has been some cooperation by farmers in the United States for many years, but within the last two decades, and particularly during the last decade, the movement has assumed proportions which indicate that it is a response to a fundamental and universal need of present-day American agriculture. It is highly significant from all points of view that the best minds in agriculture, without regard to region or commodity, are unanimous in the opinion that group action in marketing must be added to individual efficiency in production if the high standards of American farm life are to be preserved and agriculture is to maintain its proper place in our national life.

Vast problems are involved in the changes in agriculture and in commerce and industry which this movement is bringing about.

They are broader than any one class and vitally affect all classes; hence they are a proper concern of the Government.

It is the traditional policy of our Government to foster agriculture as the most essential of our industries, but without in anywise seeking to dominate or direct it. This policy must be our guide in dealing with these new problems.

Although cooperative marketing is a farmers' movement, it is not in any proper sense a selfish class movement and holds no menace either to consumers or other business interests. Agricultural production is essential to national welfare, and the only guaranty of an adequate and dependable supply of agricultural products is a prosperous and contented agricultural population. It is obvious to any thoughtful mind that this happy result can not be obtained by agriculture unless it avails itself of the efficiencies and economies of organization and specialization which characterize other industries in this day. Consideration alike of intelligent self-interest and public welfare must prompt other classes to support wise and intelligent efforts of farmers to place their important industry upon a basis of stability and prosperity.

Agricultural cooperation, as we understand it at the present time, is simply an extension of the principle of mutual helpfulness that exists between many groups engaged in industry, commerce, or agriculture. It is, however, a very definite extension of that principle. In a cooperative-marketing organization, the members do not contribute their services in the informal way in which one farmer may help another in harvesting or threshing. They take another step and contribute capital to finance a joint business enterprise, and enter into agreements which specify the duties of each member. When this occurs, cooperation takes on a more or less definite legal status, and meets problems similar to those of other business organizations. There are also special problems confronting cooperative organizations because they deal not only with marketing but with the farmers' production practices, as these practices affect marketing.

Business agriculture to-day demands that we bring about a better balance between production and distribution. American farmers can more effectively apply modern business methods to their business and effect integration in the production and distribution of agricultural products by banding themselves together in cooperative groups. In other words, I believe cooperative marketing to-day is an economic expression of group life in farming and is a natural development of business agriculture.

To place our agricultural production on a stable and profitable basis we must recognize the inseparable relation between production and marketing. The working out of a more efficient marketing system must go hand in hand with an intelligent adjustment of production to market demand in a more orderly manner so as to avoid periods of overproduction with great loss and periods of underproduction with prices unsatisfactory to the consuming public. That agricultural production may more readily become responsive to the market demands, the farmers will have to organize for marketing through the development of sound farmer owned and controlled cooperative associations.

I view cooperation in agriculture as a business agency serving the producers both as an intelligent guide in their production program and an effective instrument for merchandising farm products. Instead of thinking of cooperation among farmers as a producing proposition or as a selling proposition, we need to think of cooperation as a business form or organization that penetrates our whole agricultural industry. By this I mean cooperation, in an educational way, must reach back to production practices and forward through efficient business organization to marketing practices. It is from this concept that I look upon cooperation as a "business form or organization" adapted to the farming industry.

The chief aim of cooperative marketing is not to obtain for the producers the profits of independent merchants, but rather to contribute to and effect better merchandising methods than previously were employed in marketing farm commodities. Proper grading of farm products and standardization of grade and pack, which are essential to efficient merchandising, can be effected much more readily when farmers are organized into groups. Standardized grades facilitate trading, create confidence, and stabilize market conditions. These fundamental marketing functions, properly performed by producers, through cooperative action near the point of production, make it possible to reduce the cost of getting these commodities to market and are also a means for an intelligent use of supply, which will aid in stabilizing markets, avoiding gluts and reducing wastes.

The business transacted by cooperative buying and selling organizations will be, conservatively estimated, \$2,500,000,000 during 1925—approximately one-fifth of the total agricultural business. A movement of this magnitude, with its tremendous economic and social significance, must be analyzed and guided so that its highest possibilities may be realized. Cooperation, although firmly established, is in its infancy in this country, as compared with other economic and social institutions. This is another reason for analyzing and studying the cooperative methods and experiences accumulated to date. Actual experiences need to be collected and expressed in plain language in order that they may serve as guideposts for the future. This the Department of Agriculture has been doing since 1913, when it began some fundamental research in cooperative marketing.

The department's work to date indicates that during the past 10 years cooperation has been evolving from the local type of organization into associations and federations covering large areas and handling business totaling millions of dollars annually. Although 95 per cent of the cooperative associations are still local organizations, approximately one-third of the total business at the present time is carried on by 100 of the federations and regional organizations. They, from a business point of view, are the dominant factors in cooperative marketing.

The tendency toward combinations in the business world has had an influence on the creation of large cooperative marketing organizations. The average business of cooperative associations more than doubled between 1913 and 1922, increasing, for the organizations of which the department has record, from \$100,000, in round numbers, to \$216,000 per association. The business of tobacco marketing

associations increased from an average of \$141,968 in 1913 to \$7,606,125 in 1922; cotton associations, from \$191,112 to \$3,405,765; dairy marketing associations, from \$50,296 to \$166,683; and fruit and vegetable organizations, from \$153,336 to \$284,081. These figures do not take into account the business done by the federations of which many fruit and vegetable and dairy organizations are members.

This increase in volume of business has resulted in progress in methods of operation and merchandizing. It has brought about, on the whole, economies in operation, a greater insistence on standardized products, easier financing, and has encouraged capable executives to enter the service of cooperative associations.

Another important problem of cooperation is the development of a cooperative spirit or understanding throughout the rural communities. It will be of little value to set up large and efficient cooperative business organizations if they are not understood and supported by those whom they seek to benefit.

It is universally recognized that the future of cooperation depends upon the knowledge which the individual producer has of its possibilities and limitations. He must take a long-time view of the movement. The producer must learn to test his association, not by the price advantage it may offer him this year, but by the services through which it may contribute to the stabilization of production and distribution. Our agricultural colleges and other State and Federal institutions must broaden their curricula to include cooperative education—a form of education that will aid the members, officers, directors, and officials to a more thorough understanding of the function and meaning of cooperation.

There is also a real need for a better understanding and appreciation of the cooperative movement by the general public. Farmers cooperatives must find and fill their place in the agricultural, commercial, and industrial life of the Nation. To this end each interest must be brought to know, understand, and cooperate with the others.

INCREASING FARM EFFICIENCY

Let us not forget that after all the foundation of a prosperous agriculture must always lie in efficient and rightly adjusted production. Marketing can not be separated from production. Fitting production to the needs of the market, moreover, implies more than merely furnishing products in suitable volume. Consumers are interested in quality as well as quantity. Farmers lose millions by offering products that the market will take only at a discount. They many times lose by not maintaining a proper balance among their different enterprises, but not raising good types of livestock, by not sowing the best available seed, by not making a correct choice of crops, by not employing the right size and type of machinery, and by not managing their business to the best advantage. Probably the farmer can do more for himself on the farm than anyone can do for him off the farm.

Efficiency in farm production is a complex thing. It is not enough to produce crops at the lowest possible cost. Nor yet does it suffice to have various farm enterprises in their right relationship to one another. This may all be accomplished without insuring a profitable

agriculture. Efficiency in cutting costs and in keeping a proper balance among different farm enterprises frequently benefits the consumer more than it benefits the producer. This happens when increased facility in production leads to an increased volume of production irrespective of market needs. It is easy to see how this comes about. Not all farmers increase their efficiency at the same time and in the same degree. Those who are in the lead have an advantage over the rest. These men are of course tempted by their special profits to increase their output. As the general average of efficiency increases and production costs go down, agriculture as a whole tends to increase its production until the benefit of its lower costs is wiped out by lower prices. Obviously the only remedy for this difficulty is such an adjustment of acreage and of the output of animal products as will prevent increased efficiency from being immediately translated into increased volume of goods.

DECREASING PRODUCTION COSTS

One way in which producers can increase their effectiveness is by decreasing their costs of production. In every region there are some men producing at much less cost than the great majority of their neighbors, whereas others are producing at costs much above the average. The men who produce at low cost do so because they have learned just how to use their resources and their labor, and just what methods to use to produce most efficiently. Thus in the Corn Belt some men use 20 hours of man labor and 40 hours of horse time to produce 50 bushels of corn, whereas other men, who employ their labor more efficiently, obtain the same product with only half as much labor. The same variation in labor efficiency has been found among wheat growers, cotton growers, tobacco growers, and others. These differences are due not only to the use of labor-saving machinery, but to the fact that some men follow practices with regard to the use of fertilizer, improved seed, time of conducting operations, and methods and practices in production that make every hour of labor count.

In livestock production, too, there are equally great variations in efficiency from farm to farm, and equally great opportunities for cutting costs on many farms. Some men incur high costs by using inferior stock or feeding improperly. Others use good technical methods so far as feeding and care go, but incur extra expense by failing to adjust their rations to changing prices. The combination which is most economical at one time may be very expensive at another. Farmers need to be ever alert to make sure that they are using the most economical practices possible for each change in prices.

III. LEGISLATION

In spite of all the improvements since 1921, conditions on the farms are not yet satisfactory. Much remains to be done to put agriculture on a prosperous basis. The purchasing power of farm products in October was still 13 per cent below its pre-war level. A 13 per cent decline in the buying power of farm products occurring suddenly in normal times would be a calamity. Agriculture is convalescent now after a severe illness. We must not focus all

our thought upon the improvement effective since the crisis of 1921. Part of our attention must be directed to further improvement.

I believe our national policy should reckon with the fact that agriculture is not yet restored to equality in the general economic situation. Whatever responsibility for this situation rests with public agencies must be fully recognized. Much helpful legislation has been passed during the last five years. More can be done.

Farmers have been helped tremendously by the Federal farm loan act, whereby mortgage money is made available to them on better terms than were ever granted before. They have been assisted by the agricultural credits act of 1923, which provides a system of intermediate credit tending to relieve commercial banks of a type of farm paper that they are not well adapted to handle.

They have been assisted in orderly marketing by the administration of the Federal warehouse act, which makes Federal warehouse receipts acceptable as loan collateral in the principal money markets.

Legislation passed in recent years has defined the rights and privileges of cooperative associations and promoted their development.

Tariff legislation has been useful, particularly to dairy farmers, fruit growers, and hard-wheat farmers, sheep raisers, flax raisers, and sugar beet and cane producers.

Conditions in the livestock trade have been improved by the administration of the packers and stockyards act.

Four subjects stand out prominently as suggesting a need for legislative or administrative action—freight rates, taxation, the utilization of the public domain, and cooperation. I will discuss each of these problems in more detail later in this report. Here I merely wish to point out that in two of them, freight rates and taxation, remedies for existing evils are absolutely dependent on action by Government authorities, and that the third subject, cooperation, offers very large possibilities for useful advisory action by Government agencies acting under legislative authority.

The expansion of our farm-land area may require legislative action. I am opposed to bringing new areas under cultivation until we have found a market for the products we are now producing. There are two things the Government may do to prevent injudicious expansion of farm land. It may regulate its own land-settlement projects wisely, and it may discourage undesirable private projects. There is a field here for useful and legitimate Government activity for the protection of agriculture and the promotion of the general welfare. I am as strongly in favor of such activity as I am against attempts to determine economic law by means of legislation.

Certain recent legislation will be of definite benefit to agriculture. One significant measure enacted during the last session of Congress was the Purnell Act, authorizing additional endowments for the agricultural experiment stations. This measure will mark a new epoch in the history of the experiment stations. It will eventually treble the Federal appropriations for their support, with a corresponding breadth of research conclusions along economic lines made available to farmers.

In addition to the amounts now received by the agricultural experiment station, the Purnell Act authorizes additional appropriations

of \$20,000 for the fiscal year ending June 30, 1926; \$30,000 for the fiscal year ending June 30, 1927; \$40,000 for the fiscal year ending June 30, 1928; \$50,000 for the fiscal year ending June 30, 1929; \$60,000 for the fiscal year ending June 30, 1930; and \$60,000 for each fiscal year thereafter. This money is to be paid to each State where experiment stations are now established, and is to be used only for research and experiment. Supervision of the work done under the Purnell Act is intrusted to the Department of Agriculture, which is fully alive to the opportunity thus afforded for close cooperation between research and extension forces in Federal and State organizations. Passage of the Purnell Act was recommended by the President's agricultural conference.

Another recommendation of the conference that was enacted into legislation was a proposal that the Federal farm loan act and the agricultural credits act of 1923 should be amended to give agricultural credit corporations chartered by the United States the same privilege to rediscount paper with the Federal intermediate credit banks that is now given to credit institutions chartered under State laws. This measure is expected to foster the organization, particularly in livestock territory, of properly capitalized agricultural loan companies. A larger number of soundly organized, adequately capitalized, and properly managed loan companies operating under Federal supervision and enjoying access to the rediscounting facilities of the Federal intermediate credit banks seems very desirable. Such institutions would greatly improve the credit facilities of livestock breeders.

A third recommendation made by the President's conference related to livestock grazing on the national forests. It urged that until a uniform plan of leasing is agreed on there should be no increase in the fees charged. Congress accepted the recommendation and passed an act authorizing the Secretary of Agriculture in his discretion to waive any part or all requirements in respect to grazing fees for the use of national forests in drought-stricken regions during 1925. Simultaneously, it was announced that there would be no increases in the grazing fees charged on the national forests for the years 1925 or 1926.

Measures were also passed amending the Clark-McNary Reforestation Act and facilitating the work of the Forest Service; authorizing a forest experiment station in California; providing for a general utility topography survey of the United States; and creating an Alaska game commission.

FREIGHT RATES

I believe that we must have substantial readjustments in freight rates. High freight rates constitute one of the many causes that have contributed to the depression in farm prices, especially in areas distant from the market. It is generally conceded that the entire freight-rate structure needs overhauling. Freight rates the country over have grown up in a haphazard way and as a result of all sorts of local considerations. It is my opinion that a careful study should be made of the entire freight-rate structure. On the basis of such a study it should be possible to make rate adjustments that take into account the market value of farm products as reflected over a

reasonable period of years and likewise the influence of freight rates on the economic development of different regions and of the country as a whole. I realize that adequate income to the carriers must be fully reckoned with as a factor in rate making, because efficient and adequate railroads are indispensable to a profitable agriculture.

There have been only minor changes in the freight rates on farm products in the last year. Our index showing changes in freight rates of 50 representative agricultural commodities stood on January 1 at 158.2, or 58 per cent above the 1913 level. Since then there have been no changes great enough to affect the index.

The Hoch-Smith resolution, passed at the last session of Congress, directs the Interstate Commerce Commission to effect such lawful changes in the freight-rate structure as will promote the freedom of movement of agricultural products affected by the depression, including livestock, at the lowest possible rates compatible with the maintenance of an adequate transportation service.

In response to this order the Interstate Commerce Commission has initiated proceedings to determine among other things what products of agriculture, including livestock, are affected by the depression and what, if any, reductions may lawfully be effected in the rates of charges on products of agriculture.

Meanwhile the railroads have introduced a petition asking for a 5 per cent increase in all rates west of the Mississippi. These two cases are now being heard together, and one of the main points of contention is the farmer's ability to stand higher rates.

In relation to pre-war conditions, the prices of farm products are not yet on a par with freight rates. The level of farm commodity prices in September was 144 per cent of the pre-war average, whereas freight rates on agricultural commodities were 158 per cent of the pre-war average. Moreover, the prices of agricultural products fluctuate greatly from year to year, whereas freight rates are stable and are not frequently changed. The burden of the post-war increase in freight rates fell heavily on agriculture because the rates were increased just as agricultural prices started downward and remained high while agriculture was undergoing a very severe depression. The ability of agriculture to pay transportation charges should not be reckoned on the conditions of any given year, but on probable future conditions, unless freight rates can be made more flexible, being raised when prices are high and lowered when they decline, within reasonable limits.

THE FARMER'S TAX PROBLEM

The recent general improvement in farm earnings has been accompanied by a slight reduction in farm taxes. Recent reductions in farm taxes seem insignificant, however, when compared with past increases. Farm-land taxes in Missouri averaged 8 cents per acre in 1881; in 1924 they were 40 cents. The average tax in North Dakota was 23 cents per acre in 1916 and 48 cents in 1924. Texas farmers paid 9 cents per acre in 1914 and 20 cents in 1923. Similar increases are found almost everywhere. They have been accompanied by better roads and schools and more efficient public service in all its branches. The essential nature of many of these services assures them of continued popular support at whatever cost to the public.

Presumably it is no more possible to bring about a return of the low taxes of even 10 years back than it is to stop progress in any other field. But unless a more equitable distribution of the tax burden can be brought about, the agricultural industry may expect recurring periods when taxes will consume an undue proportion of farm income.

It is now generally recognized that excessive taxation of industrial earnings slows down production, discourages investments in productive enterprises, and generally stifles the prosperity of the country. These effects are felt by the industrial portion of the country as the result of taxes which are levied largely on the basis of earnings, and which are lighter when earnings are least. Fifty-one per cent of the total taxes paid by construction companies in 1923 were income and excess-profits taxes paid to the Federal Government alone. The percentage for manufacturing corporations was 49 and for wholesale and retail concerns it was 46.

Farm taxes, on the other hand, are chiefly general property taxes, levied by the States and the local units on the basis of capital value, and they bear little or no direct relation to current farm earnings. Only 29 out of every thousand farmers paid any Federal income tax at all in 1923. Since farm taxes can seldom be shifted to the consumers of farm products in the form of higher prices of products sold, it must be clear that the taxes now being levied on agriculture are more capable of exercising a depressing effect than are the taxes on almost any other class.

Investigations by the department bear out this belief. In 1922 State and local taxes took 59.6 per cent of rents from 23 farms studied in Monroe County, Ind. In Wells County, N. Dak., taxes on 63 surveyed farms amounted to 85 per cent of the rents for 1923. It is a matter of common knowledge that during the disastrous period from the close of the war to 1924 there were many farmers in all parts of the country who failed to "make their taxes."

It is true that the same factors which lead to high ratios of taxes to farm rents in some years also cause extremely low ones at other times. The wide differences from year to year in the relation of farm taxes to the earnings of the taxed property illustrate the need of a closer relationship between property earnings and property taxes. If property is to continue to bear a large share of the taxes levied by the States and minor political divisions, greater consideration should be given to differences in earning power which exist between classes of taxable property when tax assessments are being made.

But there is no justification for taxing only property. The great volume of income from other sources, which now escapes taxation for State and local purposes in many parts of the country, could well be called upon to assume some part of the total tax load. Income and inheritance taxes, levied by some of the States, now reach many of these classes, although in varying degree. Other special forms of taxation have been devised to supplement further the property tax and to obtain a more even distribution of the tax burden over the whole people. Broadening of the sources of tax revenue is a matter of great concern to the farmer, although conditions within States vary so widely that no particular form of taxation could be considered of equal value in all places.

Supplementary tax revenues of the types referred to are usually applied to defray the ordinary expenses of the State central governments. Counties, townships, and other local districts, exclusive of incorporated places, on the other hand, obtained 97 per cent of their tax receipts from the property tax in 1922. It is difficult to explain why tangible property should bear almost the entire local tax burden besides contributing a substantial share to the general expense of the State governments. A few of the States have adopted the practice of returning a part of their income, inheritance, and other special taxes to the local districts in which they were collected. The State of New York, for example, returns 50 per cent of its income tax in this manner. Wisconsin has a similar practice. The further spread of this practice will prove particularly beneficial to those farmers who live in local districts which include a considerable scattering of urban wealth, and in which urban populations largely determine the types and standards of public service to be maintained.

One of the most important factors which contribute to the excessive taxation of agriculture is the tendency of many States to improve the public schools and public roads largely at the expense of the local districts. Indiana farmers paid 66 cents out of each tax dollar to the counties and townships for these uses alone in 1923. Investigations in Boone County, Mo., show that 56 per cent of all farm taxes went for the same purposes in that locality in 1925.

Both the highway and the public school have outgrown their early local surroundings. The motor vehicle has made a State and national problem of the public road. School standards have been pushed forward step by step in all of the States by means of general laws.

The time has come when the States should face the highway and school problems frankly, and determine upon methods of financing which are consistent with the benefits which those institutions confer upon the State as a whole.

THE GOVERNMENT'S RELATIONSHIP TO COOPERATIVE MARKETING

The relationship of the Government to cooperative associations may be loose and informal or close and authoritative. It may range all the way from a mere let-alone policy to one of thoroughgoing supervision and minute regulation. Neither extreme, of course, is within the range of practical policy. The Government is already performing services for cooperation that put the let-alone policy out of consideration.

On the other hand, it is not proposed in any responsible quarter that the cooperative movement should be hampered by Government regulations. Cooperation in the United States has developed from the needs and experiences of the farm people. The weight of experience in this country shows that it should begin as an economic movement of the rural communities and that it should be free to develop in accordance with their needs and the opportunities for service. The experience in European countries also points to this fact. It is improbable that the Danish Government, for example, at any time during the history of the cooperative movement in that country could have developed a plan of cooperation as admirably adapted to the needs of the Danish farmers as is the present system. Neither

is it likely that the Danish Government by decrees or regulations could have made cooperation the important part of the national life that it has come to be through spontaneous, untrammelled growth.

It seems obvious that supervision and control are not desirable. Cooperative associations are business concerns. Like other business concerns they must eventually stand or fall by themselves. They can not fairly be asked to accept a degree of regulation and control from which private distributing agencies are exempt. Removing responsibility for their actions from the cooperative associations themselves to the Government might be fatal to their efficiency. It would certainly not encourage men of executive ability to seek managerial positions in the movement. Efforts to regulate cooperation minutely by law or by administrative edict would cripple the initiative of the cooperative associations and force them into a rigid mold when their greatest need is flexibility. Excessive regulation might smother the movement.

What the department is already doing indicates the nature of the service it can give to cooperation. It is studying marketing problems and making surveys indicating what are the prospects of various cooperative projects. It is examining the causes of success and failure in cooperation, and giving counsel to association boards of directors and managers. It is helping by counsel and advice groups of farmers to develop effective organizations and to plan wise merchandising policies. It is popularizing the use of uniform and up-to-date accounting systems and office records among cooperative associations. It is analyzing marketing operations to reveal their strong and weak spots and assisting associations in developing their own methods of market analysis. It is aiding cooperatives to extend their markets at home and abroad. It is acquainting American cooperators with the experience of cooperators in other countries. It is furnishing market-news services, and establishing commodity grades and standards to facilitate trading. It is helping producers to correlate their production plans, so that the hills and valleys of production can be leveled out to some extent.

What the Government can do further to assist the cooperative movement depends upon the funds available for such work and the demands of the cooperative associations. The department stands ready to extend its services to the full extent of its present facilities, and to recommend such enlargements of its research work and services as shall appear advisable after consultation with the cooperative organizations and a careful survey of their needs. The direction which further services should take can best be indicated by considering the problems confronting cooperative associations at the present time.

The personnel of the Bureau of Agricultural Economics is studying the problem of marketing and distributing farm products. To put the information in a form in which it will be immediately available and useful to the cooperative organizations requires a type of extension workers which the bureau does not have at the present time.

One possible means of further service to the cooperatives, therefore, is the employment of commodity specialists, who would be familiar with the needs of the cooperative organizations on the

one hand, and with the research and service work of the department on the other hand. These men would form a contact between the associations and the department, and would disseminate current crop and market information, and information regarding price trends, conditions of supply and demand, and other useful information. At the same time, they would be instrumental in guiding the research work of the department toward a closer study of the special problems of cooperative associations.

The business organization and management of cooperative associations will always be of paramount importance. The business analysis studies that have been begun could be profitably extended. This is in line with the practice of large corporations which are devoting considerable sums to research in the fundamental problems of merchandising, production, financing, and management. If the cooperative associations are to reach the same plane of efficiency as private organizations, it is desirable that they have the advantage of similar studies. The department can not undertake to do this work for the cooperatives, but it can, very properly, outline the field and develop methods in this important and difficult undertaking.

A third problem, not the least important, is the dissemination of knowledge to farmers regarding the principles and aims of cooperation. This is important to forward the development of sound cooperation. The department can make an important contribution in this field. The employment of specialists in cooperative education, to work with State agricultural colleges, State boards of agriculture, and the cooperative associations in promoting the knowledge of cooperative principles and practices, should be helpful in developing a sound point of view toward the movement.

I have indicated only some of the larger problems in which the department can properly render assistance. There are others of almost equal importance and still others will arise as cooperation advances. It is hoped that the department's services to cooperative associations will establish a closer relationship between the organized farmers and the State and Federal agencies engaged in scientific research in the field of agriculture. These agencies can serve all producers by a special effort to make their services and the results of their research available to the organized groups.

AGRICULTURE AND THE PUBLIC DOMAIN

The existing policy with respect to land utilization on the public domain has had much to do with the troubles of western agriculture in the past few years. Permitting the public domain to be sporadically occupied by homesteaders in holdings of uniform size with little reference to the capacity of such a holding to maintain a family except as determined by the inexperienced settler, has added greatly to the unnecessary loss and misery attending the process of agricultural expansion, has contributed to the undue development of cereal production from which our established farmers have suffered, and has greatly complicated the problems of the range industry.

Furthermore, allowing the unappropriated and unreserved lands of the public domain to be used as a grazing commons has greatly

increased the instability of the livestock industry of the West. That portion of this great industry dependent upon the public domain, involving an investment of hundreds of millions of dollars, is engaged in a competitive struggle to obtain the limited grass on the public lands on the principle of "first come, first served." It is true that some of the stockmen have been so fortunate as to secure practically exclusive control of the use of certain areas of the public domain through the ownership of strategic locations for water supply, or through other favorable conditions, but the great majority have no such immunity from cut-throat competition.

Under such conditions there is a premium on destructive and wasteful use. Each man tries to get his stock on the young and tender grass ahead of his competitor and close-graze it till the last sprig is gone. It is impossible to maintain a reserve supply of forage against a dry season. It is equally impracticable to co-ordinate properly the seasonal use of the range on the national forests or other lands with that on the unreserved public domain.

As a result of these conditions the public range lands are steadily deteriorating in usefulness. While potentially a valuable national resource, the forage is being destroyed by improper use. Moreover, the denudation of the land has greatly increased erosion and has intensified the destructiveness of floods. Experiments, investigations, and practical demonstrations have shown that denuded range lands can be restored under a system of regulated grazing which will arrange for the right number and class of stock at the proper season of the year, provide for the even utilization of the range and permit the most valuable species of forage to mature seed. However, it is impossible to employ such methods of utilization on the 180,000,000 acres of unallotted and unreserved public domain under our existing land policy.

For a number of years interested persons and agencies have agreed that a far-reaching change of policy is imperative. Indeed, each year for the past two decades some form of legislation relating to this problem has been introduced in Congress, but because of the diversity of opinion owing to the varied conditions in different parts of the West, no far-reaching legislation has been passed. At the present time a congressional committee is giving the problem careful study, and it is for Congress to determine the exact form of policy which shall be developed. Indeed, the exact form of policy or the decision as to what agency shall be charged with its administration are comparatively unimportant provided that the problem shall be settled in such a manner as to promote an adequate utilization of the public domain and a stabilization of the range industry. In order to accomplish these purposes it will be necessary to recognize certain basic facts and principles:

1. It is uneconomic to permit homesteaders to take up land at random on the public domain. Such a policy works havoc in the established grazing industry, and at the same time encourages settlers to undertake a farming enterprise impossible of success. Much of the homesteading has been merely for the purpose of selling out to ranchmen, forcing the latter to increase their capitalization unduly, sometimes in the face of falling prices for livestock or credit strin-

gency. Careful selection should be made of such portions of the public domain as afford a reasonable promise of successful farming, not in scattered holdings where the possibilities of developing a satisfactory community life are remote. The remainder of the public domain should be definitely devoted to the range industry until such time as changing physical or economic conditions justify a different form of use.

2. In many localities the public domain is only one segment of the circle of year-round provision of feed for livestock. It must be adequately coordinated with the use of the summer pasturage of the national forests, as well as with the provision of winter feed on lands capable of raising crops. As my predecessor expressed it in his annual report for 1923: "Unregulated spring range has become the neck of the bottle. Winter feed and summer pasturage are available for more stock than can be subsisted during the interval unless the spring range on the open domain can be protected from overgrazing and utilized in a coordinated way with the other and stable factors in the round of the year." The economic stabilization of the livestock industry should be promoted by providing adequate reserves of pasturage against recurring years of drought by a reasonable degree of elasticity in grazing fees or in rentals, and by the utmost practicable stability of tenure consistent with the public interests involved.

3. The privilege of grazing based upon prior use and occupancy and the ownership of improvements on adjacent property employed in connection with the public range should be fully recognized and carefully conserved. Attention should also be devoted to providing sufficient pasturage for the requirements of homesteaders and other farmers in the vicinity of the range. Suitable provision should be made for necessary ingress and egress, and for the movement of livestock, also for prospecting, locating, developing, and patenting mineral resources.

4. So far as practicable the principle of local option should be observed in extending regulation over the public domain, and the policy of local self-regulation should be employed in developing a uniform program consistent with the larger public interests involved.

IV. THE DEPARTMENT OF AGRICULTURE: GENERAL ADMINISTRATION

The business policy of the department is to insure value received to the taxpayers for every dollar spent for Federal activities. The cooperation displayed by members of the department in carrying out this policy is gratifying. Typical instances of economies effected, better business arrangements established, etc., during the year have been reported to the Budget Bureau and will be found in the annual report of the director of that bureau for 1925, pages 109-118.

An important reorganization of the central business administration of the department has been effected to concentrate authority and responsibility, establish better and more economical administration, and eliminate duplication of work and superfluous or overlapping procedure. Under the new arrangement an officer of the department has been designated as director of personnel and business

administration, to supervise and coordinate all departmental business activities, including personnel administration, budget, fiscal and accounting matters, purchasing of supplies and equipment, traffic, housing, etc.

As a part of this plan nine offices which formerly reported directly to the Secretary have been consolidated into one organization designated as the Office of Personnel and Business Administration. The branches consolidated were (1) the office of personnel; (2) the salary classification office; (3) the office of budget and finance; (4) the division of accounts and disbursements; (5) the office of accounts serving units under the office of the Secretary, office of publications, office of experiment stations, agricultural extension service, and bureau of home economics; (6) the division of purchases and sales; (7) the office of the traffic manager; (8) the office of personnel and fiscal inspection; and (9) the office of the chief clerk of the department, and subsidiary units, which include the mechanical shops, building maintenance, department post office, telegraph and telephones offices, section of mail and files, and similar units.

The new arrangement has been in operation a sufficient time fully to justify its establishment and to demonstrate its value in facilitating business. It has already resulted in a material saving in personnel and salary expense. Further improvements and reductions in such costs are in prospect.

CENTRAL UNITS MERGED

In a similar manner the office of publications and the press service, the two central units of the department engaged in information and publication work, have been brought together in one organization which has been designated as the office of information and placed under a director of information, who is charged not only with the administration of this unit but also with the general supervision and coordination of the information and publication activities of all branches of the department. This arrangement has resulted in a much more efficient and satisfactory handling of the work and in a reduction in operating costs.

In connection with the reorganization of the central business administration of the department, assistance has been given during the year by the United States Bureau of Efficiency, which, at the request of the department, has assigned several members of its staff to make detailed studies of present methods of operation, with a view to suggesting such further changes as may be beneficial. It is necessary that the departments have an agency of this type which can be called on to furnish trained investigators for the purpose of conducting investigations upon which improvements in operation may be based.

On June 30, 1925, the department had on its rolls approximately 20,500 employees, of whom 4,800 were located in and 15,700 outside of Washington. The turnover in the personnel during the fiscal year 1925 was 11.49 per cent, or 2.32 per cent less than for the preceding year. The application of the salary classification act has brought about a material improvement in the employment situation in the department. Progress has been made in establishing more

uniform rates of pay for equal work, but some inequalities still remain which can not be satisfactorily adjusted until additional funds are made available for this purpose. The following, in so far as practicable, of the general policy of filling vacancies by advancement from within the ranks and the granting of a reasonable number of promotions on the basis of demonstrated efficiency and productive service has had a very salutary effect on the morale of the employees of the department as a whole.

HOUSING SITUATION

The housing situation of the department continues to be deplorable. More than 40 buildings widely scattered over the city of Washington are still occupied by departmental activities. This seriously interferes with the administration of the work of the department and is extravagant rather than economical. Aside from the better administration and supervision to be gained by properly housing the departmental activities material economies in guarding, cleaning, messenger service, and trucking service could be effected if the department were housed in fewer buildings more closely related to each other and to the central administration.

A committee headed by the Assistant Secretary, which I appointed to consider the problem, has reported in considerable detail upon the department's housing requirements, with specific recommendations for meeting the situation. The suggestions contained in this report are receiving my careful consideration, and it is hoped that they may prove of value not only in meeting the needs of the Department of Agriculture but also in connection with the general subject of Government housing in Washington. In brief, the report recommends the construction of the long-delayed central building connecting the two existing marble wings which were erected in 1908, and at the same time the erection of a large structure upon Government-owned land at the north end of the department's reservation. On the basis of meeting present needs it is believed that the adoption of these recommendations would provide adequate housing for the department.

V. THE DEPARTMENT OF AGRICULTURE: ECONOMIC RESEARCH AND ADMINISTRATION

The farm population of the United States decreased approximately 182,000 during 1924, according to the estimates based on a survey of 25,000 representative farms recently made by the department. This is a drop of 0.6 per cent during that year, the estimated farm population on January 1, 1925, being 31,134,000 compared with 31,316,000 on January 1, 1924. This estimate includes not only the agricultural workers, but all men, women, and children living on the farms on that date.

The movement from farms to cities, towns, and villages in 1924 is estimated at 2,075,000; the movement to farms was 1,396,000, making a net movement from farms of 679,000 persons, or 2.2 per cent. Births among the farm population during 1924 are estimated at 763,000 and deaths at 266,000, making a natural increase of 497,000,

which reduced the loss due to the cityward movement to 182,000 or 0.6 per cent.

A similar estimate made two years earlier for 1922 showed a loss in farm population of 460,000 as against 182,000 in 1924. The gross movement from farms to cities in 1922 was 2,000,000 compared to 2,075,000 in 1924, a slight increase. The gross movement back to the farms in 1922 was 880,000 compared to 1,396,000 in 1924, a very decided increase. The net movement from farms to cities in 1922 was 1,120,000 or 3.6 per cent and in 1924, 679,000 or 2.2 per cent.

Two geographic divisions, however, the New England and South Atlantic States, showed an increase in farm population for the year 1924, of 0.9 per cent and 0.2 per cent, respectively. All other divisions showed decreases, the Mountain States leading with a loss of 2.8 per cent.

The decrease in farm population due to the cityward movement, not taking into account births or deaths, was highest in the Mountain States, 4.3 per cent, followed by the Pacific and west South Central States. In all other divisions, except New England, the percentage of decrease due to the cityward movement was equal to or less than the average for the whole United States (2.2 per cent). New England alone showed a gain of 0.3 per cent, since more people moved from cities to New England farms than left farms for cities.

The movement from farms to cities was found to be at highest rate in the Mountain States, 13.8 per cent, followed by the Pacific, New England, Middle Atlantic, and east North Central States in order. In the movement to farms from cities, the Mountain States, again lead with 9.5 per cent, followed by the New England, Pacific, Middle Atlantic, and east North Central States.

Movements of population from the farm to the city and from the city to the farm are an important index of the agricultural situation. A glance at these movements during the last five years throws light on present tendencies.

Apparently in 1920 there was a net gain in total farm population of approximately 500,000. The total in 1919 according to the census had been 31,614,269. Unusual prosperity in 1920 apparently restrained the customary flow to the cities of young people between the ages of 20 and 25. Moreover the annual movement of prosperous retiring farmers to town was offset by the arrival of city people drawn to farming.

In the following year an opposite tendency was manifested. The collapse of farm commodity prices in 1921 was accompanied by an unusual movement of population to the cities. As a result, the net increase of farm population during the year was only 200,000.

In 1922, according to a survey made by the department, the net movement of persons to cities reached the 1,000,000 mark, and there was a net loss in the farm population of 460,000 persons.

The loss of farm population continued in 1923, causing a net decline equal to and perhaps exceeding that of the preceding year. Apparently, however, the movement reached its height in 1923.

As the figures above quoted show, a survey made in 1924 indicates that although the forces tending to drive people to the cities were still strong, opposing forces were sending back from the cities a

larger number than formerly, so that the net loss of farm population for the year was reduced to 182,000.

Opinions as to the make-up of the return movement of population to the country in 1924 are necessarily speculative. Doubtless the return flow included many farmers who had sold farms in recent years but had been obliged to take them back because the intending purchasers were unable to maintain their payments.

Others were probably farm owners who found after a year or so of trial that they could not afford to live in the city on the rents from their farms. Probably also there were many former farm tenants and laborers who had not found their expectations of city life fulfilled. It seems that the trend of farm population is now returning to normal.

In normal times there is a constant interchange of population between the country and the city. As farmers retire to cities, so city people retire to farms. Laborers move back and forth from farm to city and from city to farm. On the other hand, a stream of youth of both sections representing the farm-reared human surplus moves permanently from the country to the town. It would seem that all agencies working for the general welfare, whether rural or urban, should do what is possible to reduce to a minimum the inevitable dislocations caused by this interchange of population. There is a natural balance of population between the farm and the country which can not be violently disturbed without heavy loss in economic and human values.

THE FARMER'S COST OF LIVING

A study made of the cost of living among 3,000 widely scattered farm families indicated that the average total value of goods and services used per family in one year was \$1,504. Of this value, \$634 was furnished by the farm in food, fuel, and housing.

Among the several items of living, food took 41.2 per cent of the expenditure; clothing 14.7 per cent; housing 12.4 per cent; health 3.9 per cent; education, etc., 6.3 per cent; life insurance 2.3 per cent. Compared with about 12,000 industrial families these 3,000 farm families spent about 3 per cent more of their total expenditure for food and 1 per cent more for fuel and light, but they spent 2 per cent less for clothing and 1 per cent less for house rent.

Although some wide variations in family living costs were found among different groups in the same States, the average living cost per family by States did not vary much. It was found that farm families increased their proportionate expenditures for recreation, education, health, and advancement generally as their total expenditure increased.

PRICE SPREADS IN DISTRIBUTION

Spreads between prices received by producers and those paid by consumers of agricultural products are of great interest and importance at this time. The most important factor in the creation of these large spreads is the cost of extensive services imposed upon the distribution structure as a result of present-day methods of living. Services multiply in the terminal markets. It is here that the greater portion of the difference between producer price

and consumer price is incurred. Studies conducted by the department indicate this fact. A total of 64 per cent of the difference between the price received by the producer and that paid by the Chicago consumer of Wisconsin potatoes during the 1922-23 season was absorbed in the movement through wholesale, jobbing, and retail agencies within the city. During the same season 72 per cent of the spread between the producer price and the price paid by the consumer of northwestern Winesap apples was taken up by marketing agencies in the New York port district. In 1920-21 a study of Connecticut onions sold in the Boston market shows that 79 per cent of the spread between producer and consumer was incurred within the city.

Study of city distribution margins and contributing factors has been carried out in some detail in the New York port district in co-operation with the port authority. Various phases of terminal distribution including jobbing and retail margins on 14 important fruits and vegetables sold within the port district during the February 1923-May 1924 period were studied. Although this study relates particularly to conditions existing in the New York port district facts of general importance have been brought out. The combined jobbing and retail margin for the 14 commodities was found to be about 47 per cent of the final retail price. About four-fifths, or 80 per cent, of this combined margin measures the size of the average retail margin for the 14 commodities.

Terminal handling costs, which consist mainly of freight-car movement within the terminal area and truck hauls to jobber and to retailer, amounted on the average to somewhat less than 10 per cent of the retail price. These costs for a sack of Michigan potatoes were greater for the terminal movement of about 15 miles than they were for the entire road haul of over 1,000 miles. The chief element of cost in terminal handling is that of trucking. An analysis of this item of expense indicated that of the average dollar paid as trucking charges on fruits and vegetables, 25 cents went to pay for idle time because of lack of work during trucking hours, 21 cents were necessary to meet the expense of unproductive work—delay at terminals, trips with part loads, and other partially wholly unproductive efforts—26 cents paid for operating expenses incurred during productive operation, 14 cents were required for loading expense, and 14 cents remained for the owner as salary and profit.

Thus 46 cents out of each dollar received from trucking charges were required to maintain facilities in idleness and unproductive service during working hours. Notwithstanding the extent of distribution inefficiency indicated by this analysis, there appears to be but slight possibility of any great saving in trucking costs with the present handicap of out-of-date receiving arrangement. New methods of handling and more modern receiving facilities are required before the cost of trucking can be materially reduced.

The largest scale single segment of the spread absorbed by any one agency is that required for retail service. That the consumer pays for increased services by higher prices is plainly apparent. Equal quantities of fruits and vegetables of similar grades were sold in New York cash and carry stores at prices which averaged 14 per cent under those charged in credit and delivery service stores.

The consumer also pays for the privilege of being afforded a variety of sizes and qualities of a particular commodity from which he may select the ones most suited to his needs and of being allowed to purchase in small quantities. In these circumstances the cost of storage space and the risk of spoilage which appears to amount to about 5 per cent are borne chiefly by the retailer.

It is surprising to note that, regardless of the variation in the average quantity purchased of each of the commodities included in the New York study, the combined jobbing and retail margin was about 12 cents on the average-sized purchase of each commodity. Since the average quantities purchased varied from 1½ pounds for western to 6½ pounds for old potatoes, it seems apparent that the distributing cost was occasioned by the making of the sale rather than by the size or value of the sale. Reduction of this expense, therefore, would appear to lie in an increased size of consumer purchase of each commodity. In bringing this about, the consumer has definite responsibilities in assuming a portion of the spoilage risk now borne by the retailer and in providing adequate storage space for increased purchases. Whether such changes in consumer purchasing habits are desirable or possible remains to be proved.

As a result of the studies in the distribution field, it appears that profits of the various distributing agencies are not of first importance in determining the wide spreads observed between producer prices and prices paid by consumers of certain agricultural products. Profits are of relatively small significance when expressed in terms of the retail price to consumers. It is the cost of services rendered by the various agencies of distribution which are of greatest importance in causing wide spreads.

THE FARMER'S USE OF MARKET NEWS

The increased interest and use of economic information by farmers is shown by direct requests to the department for facts concerning supplies, shipments, prices, stocks and market trends, and also by the calls for material by various news distributing agencies, particularly the press associations, newspapers, and radio broadcasting stations.

The extension services of the department and the States have assisted in the distribution of all types of economic information. A general quickened interest has been reflected by the extension workers in all subjects. Several States have developed well-organized plans for distribution of crop and market information before series of local meetings, to lists of leading farmers, through county agents, farm organizations, and local press. Special acknowledgment is due to the newspapers of the country for their cooperation in the department's campaign to get the facts of agriculture to farmers and all classes of traders who handle farm products.

The market news service organization has been conducted during the last year without material change in personnel but with a decided increase in the quantity of facts gathered and disseminated. The leased-wire system now includes about 7,300 miles of leased wire, reaching from coast to coast and into Northwest, Southwest, and Southeastern States, which transmits the basic information from the national markets, gathered and distributed through 30 branch

offices of the Bureau of Agricultural Economics. Practically every farm commodity is included in this service, although a complete price-quotation service is not maintained on all of them.

The news service on fruits and vegetables has been made immediately available to producers in numerous key producing areas by the maintenance of some 37 separate field stations during the shipping period of the commodities involved. In the subject of fruits and vegetables alone over 10,000,000 copies of mimeographed reports were distributed throughout the year directly to producers and tradesmen. The Grain Market News Service has been extended to the Pacific coast and now includes news on the western barley crop.

Foreign market news on important farm products gathered by our foreign agricultural commissioners or the International Institute of Agriculture has proved to be very useful to our producers of these products. The principal effort is to interpret the significance of foreign conditions in terms to aid farmers and others in making plans for market operations.

THE GRAIN FUTURES ADMINISTRATION

The Grain Futures Administration during the last year has continued its activities in analyzing the character of the transactions in futures on the various grain exchanges designated as contract markets under the grain futures act. In addition to the reports received daily from the clearing members of the contract markets, a close supervision of the exchanges was maintained through the examination of books and records of the important commission houses, not only in Chicago but also in New York and other outside cities.

The volume of trading during the year was unusually large, owing to enormous speculative activities on the part of professionals as well as the general public. The total trading for all grains on the 10 contract markets amounted to 31,416,196,000 bushels bought, with an equal volume sold. Of this quantity 27,942,493,000 bushels, or 89 per cent, represents trading on the Chicago Board of Trade. The trading in wheat represented more than 60 per cent of the total for all grains, the volume being 18,875,971,000 bushels, of which quantity 16,587,110,000 bushels, or 88 per cent, represents transactions on the Chicago Board of Trade.

It is therefore clearly evident that the transactions in grain futures are governed almost exclusively by the activities at Chicago, where most of the hedges are placed, although the market is primarily speculative in character.

In connection with the trading at Chicago it is of interest to compare the actual deliveries on futures contracts with the total volume of trading, the total deliveries in wheat being 31,571,000 bushels and in corn 12,950,000 bushels. In each of these grains the deliveries were less than two-tenths of 1 per cent of the total sales for future delivery.

During the latter part of the fiscal year the grain futures administration was engaged in an exhaustive inquiry into the activities of professional speculators, especially in wheat. This inquiry was instituted because of the sensational character of the market, which was marked by wide daily fluctuations and by sharp advances and drastic advances and declines in prices.

Although the investigation carried on by the grain futures administration did not disclose such large individual accounts as were commonly reported, nevertheless lines of several million bushels of wheat futures, sometimes long and again short, held by individual professional speculators, were not infrequent during the first three months of 1925. During the life of the May future fluctuations of 5 cents or more occurred on 52 days. On 16 days the fluctuation was 8 cents or more and on 6 days 10 cents or more without any apparent reason other than heavy speculative activities.

The largest long interest discovered in any one future was slightly in excess of 7,000,000 bushels and the largest individual short interest at any one time was nearly 5,000,000. The investigation revealed only eight speculative accounts that reached a net position of 2,000,000 bushels or more, either long or short, and some of these changed frequently from one side to the other, moving the market in line with their operations unless counteracted by a similar force. In 80 per cent of the cases where such transactions involved a change in net position of 2,000,000 bushels or more the price movement was in the same direction, with an average change in price of $5\frac{7}{8}$ cents.

At the request of and in cooperation with this department, a number of the central markets have voluntarily set up administrative machinery for the purpose of preventing unwarranted price fluctuations. Committees on business conduct have been appointed, whose members are pledged not to speculate for their personal account. Broad powers over the business conduct of members of the exchanges are to be exercised by the committees. They are also authorized to limit daily fluctuations in the market prices of grain during emergency periods. The Chicago board also adopted a suggestion that it should establish a modern clearing house. Probably no more progressive and far-reaching steps were ever taken by the exchanges to insure prices accurately reflecting supply and demand conditions. I believe they will be effective. The adoption of these plans makes it possible for the department to cooperate with the exchanges in furthering the objects of the grain-futures act. Laws are most effectual when met by sensible, sound cooperation on the part of everybody concerned.

THE PACKERS AND STOCKYARDS ADMINISTRATION

The Packers and Stockyards Administration is a separate unit of the department, organized to carry out, under the direction of the Secretary, the purposes of the packers and stockyards act, passed August 15, 1921. Within the period of less than four years during which the administration has functioned, its activities have involved all the important phases of livestock marketing. The guiding policy of the organization is to carry out the spirit as well as the letter of the law as nearly as possible in accordance with its purposes, which, in a general way, are to promote fair, impartial, open, and competitive conditions in the livestock and meat-marketing process of the country. In doing this, the administration endeavors to cooperate fully with all other factors in the industry and to coordinate its own efforts with theirs in whatever way seems best for the welfare of the industry and the public.

It has been found that the functions of the administration can be performed in many instances to best advantage by proceeding

in an informal manner, and this plan is followed in all instances in which the requirements of the act can be met in this way. There are cases, of course, which can only be handled through formal procedure. There are numerous matters which require regular attention by the administration, such as registration by market agencies and dealers, filing of tariffs by market agencies and stockyard companies, posting of new stockyards coming within the jurisdiction of the act, the regular auditing of books and records of persons subject to the act, the classification and tabulation of information contained in periodical reports, and similar activities. In addition to these regular functions, of course, the necessary attention is given to the irregularities which the law is intended to prevent.

Through an amendment to the general rules and regulations promulgated under the act, effective September 1, 1923, bonds were required of commission men covering funds handled by them in a fiduciary capacity. Through a rider in the acts making appropriations for this department for the fiscal years 1925 and 1926, the authority of the Secretary was extended, authorizing him to require bonds of all market agencies and dealers for the purpose of securing payment for all livestock purchased by them at the public markets, and the general rules and regulations of the administration were amended accordingly, effective November 1, 1924. There are numerous instances in which these bonds have afforded protection to shippers and others interested in livestock marketing amounting to several thousands of dollars.

The matter of suitable scales and proper weighting of livestock has received additional attention during the fiscal year. The administration has two weight supervisors, who devote their attention to the weighing facilities. Satisfactory progress is being made in the installation of more adequate methods for the testing of scales.

There are local supervisors stationed at 20 of the leading markets. In addition to their usual duties of observing the general marketing operations and bringing about improvement along lines indicated by the packers and stockyards act, the supervisors have given special attention during the year to the weight and quality of feed fed in the stockyards. As a result of this special effort, material improvements were made in the character of the service rendered in connection with the feeding of livestock.

At the close of the fiscal year there were 76 public stockyards, approximately 1,200 market agencies, more than 4,000 dealers, and approximately 850 packers subject to the law. It was estimated at the close of the fiscal year ended June 30, 1924, that approximately 500 packers were subject to the law. Although this estimate was based on the best information available at that time, it has been found to be too low. The change in the estimated number of packers subject to the law from 500 to 850 is due to a revision of the estimate and not to an increase in the number of packers.

THE ARMOUR-MORRIS MERGER

The complaint of the Secretary of Agriculture against Armour & Co., of Illinois, Armour & Co., of Delaware, North American Provision Co., J. Ogden Armour, and Morris & Co., issued February 17,

1923, was dismissed without prejudice September 14, 1925. This complaint was filed as the result of the acquisition by Armour & Co. of the physical properties, business, and good will of Morris & Co., the basis of the complaint being section 202, subdivision (e) of Title II of the packers and stockyards act, which reads as follows:

It shall be unlawful for any packer to engage in any course of business or do any act for the purpose or with the effect of manipulating or controlling prices in commerce or creating a monopoly in the acquisition of buying, selling, or dealing in any article in commerce or of restraining commerce.

Extensive hearings were held at the principal markets. My conclusion was that there is nothing in the act which specifically prohibits the purchase by one packer of the physical assets of another. Therefore the purchase was not illegal unless it was made with the intent of manipulating or controlling prices in the buying of livestock in commerce or in the sale and distribution of livestock products, or of creating a monopoly in the acquisition of buying, selling, or dealing in such articles in commerce or of restraining commerce. The purchase was made for the purpose of effecting economy in the conduct of the business of Armour & Co., by reducing overhead expenses and increasing the volume of sales of the finished products.

The effect of this purchase has not been unduly or arbitrarily to lower prices to the shipper or increase the price of livestock products to the consumer or otherwise to manipulate or control price in commerce. The evidence shows that competition in the purchase of livestock and in the sale of meat and meat food products in interstate commerce has not been diminished or materially lessened by reason of the purchase, and consequently the acquisition of the Morris properties by Armour has not had the effect of creating a monopoly. Furthermore, there has been a marked growth in the independent packing industry in recent years, and competition has been keen and active.

AID TO PRODUCE GROWERS

The fruit and vegetable business is now a billion-dollar concern. A million cars were required to transport the last crop to market, exclusive of large shipments by motor truck and wagon. The distribution of this tremendous volume of perishable foodstuffs has become a problem of increasing complexity. Rounding out a decade of effort in this field shows the marketing services of the department as an integral part of the industry. The news service, with offices in 18 large markets, also maintains 37 field stations in important regions of production. A total of nearly 11,000,000 reports were issued during the year. Producers are now operating with a greater knowledge of crops, shipments, market receipts and prices than was available to the largest distributors prior to the inauguration of the service. The dissemination of this information has been further augmented through the cooperation of the press and by radio broadcasting. Through certain economies it has been possible, without added appropriations, to increase the number of market reports distributed by 27 per cent. Also, the cost of assembling carlot shipment information has been reduced one-fourth through a consolidation of telegraphic reports.

The value of the market news service is generally recognized. This has been shown through many commendatory letters from the trade. Better proof is shown in the voluntary contributions from the shippers to support additional field stations. These temporary stations operate in important producing areas during the shipping season only. Current prices in the large centers, supplies on hand, the tone of the market, and shipments from competing points are reported. Such an office has been operated in Brawley, Calif. It costs about \$2,000 annually. Half of this amount is subscribed locally. From this area 13,000 cars of cantaloupes are moved in 10 weeks. At a daily meeting a Federal representative presents on a large chart a report for the day, and a schedule of distribution is then worked out through the cooperation of the shippers. The market supplies of the country are stabilized, alternate gluts and famines avoided, all to the mutual advantage of the growers and the consuming public. At the close of the season the department's representative was given a ring and his assistant a watch as a mark of the shippers' appreciation of this service.

The inspection of perishables which was extended to points of production in 1922 won instant recognition. This service, conducted in most cases in cooperation with State marketing agencies, provides for the certification of the grade, quality, and condition of the product, on the voluntary request of financially interested parties. As the work is supported almost entirely by the fees assessed, it has not become a burden on the taxpayers. The certificates are invaluable as a basis for long-distance trading and in the settlement of transportation claims. During the past fiscal year certificates were issued on over 130,000 cars of fruits and vegetables, in addition to 30,000 cars which were inspected in the terminal markets. Effective distribution has been encouraged through a steady supply of standardized products.

The possibility of the department offering its services in connection with the arbitration of trade disputes is a promising development. Since the close of the United States Food Administration there has been a continuous demand for a means of settling such controversies without the delay and expense of the usual court procedure. I believe that there is a real opportunity here to remove one of the greatest causes of waste in distribution, and at the same time to reduce the costs of marketing. The sums of money involved in such disagreements are usually relatively small in any single transaction, but the aggregate economic losses in time, telegraphic expense, costs of diversions to other markets, and in the deterioration of the products are enormous. In 1922-23, 15 per cent of the apple shipments of Washington State, totaling nearly 30,000 cars, were involved in disputes. The season was unusual on account of the disrupting effect of a strike on the transportation systems, but such situations do arise periodically. Further, this was but a small fraction of the three-fourths of a million cars of fruit and vegetables shipped that year.

Following preliminary conferences with individuals in the trade, I submitted a basis for the standardization of trade terms, trade practices, and methods of adjustment at a conference of representatives of the industry in May. This proposal has been discussed at a number of national trade conventions and has now won widespread

support. Plans are under way to handle a sufficient number of voluntary requests for arbitration to test the feasibility of the project under actual commercial conditions.

RANGE BEEF-CATTLE PRODUCTION

A study of beef-cattle production in the Western States has been made by the department to assist producers in keeping their production adjusted to the demands of the market and in determining the least-cost methods of production under present and prospective conditions. The study was also designed to show the comparative advantages and disadvantages of the different types of livestock in the different areas and the probable market demand for them.

The findings of the investigators are being made the basis of the livestock-extension program in the northern Great Plains. They justify a firm belief in the future of the beef-cattle industry in the region. Ranchmen there have cut their operating costs to a minimum, and conservative ideas prevail as to values and results of grazing lands.

Since practically all of the public land in the area has passed into private ownership, there is need of a readjustment whereby the poorer classes of homesteaded land and other grazing lands can be consolidated into ranch units such as to allow a size of business which will result in high efficiency of production and a good standard of living for the ranch family. The tendency on the specialized beef-cattle ranch is toward a unit which maintains at least 150 breeding cows. The number of cattle and not the area of land determines the size of the ranch business. There is universal agreement among ranchmen that control by the individual of the land he grazes and proper valuation of that land for grazing purposes are absolutely essential. Overvaluation of grazing land has been an important cause of failure in ranching.

DEVELOPING LOCAL MARKETS

Studies of areas around growing cities have been made to determine how far farmers are meeting the needs of their local markets and to obtain an economic basis for production and marketing programs. Investigations of the kind have been completed at Lebanon, Pa.; Roanoke, Va.; Macon, Ga.; Atlantic City, N. J.; Keene, N. H.; and Lima, Ohio. They have been helpful in pointing out market requirements as regards both quantity and quality of farm products. It was found that changes in transportation costs necessitated many adjustments in farm production.

Around Lebanon, Pa., where the sale of whole milk furnishes the major cash income, it was found that producers were not meeting the quality and seasonal requirements of the Philadelphia market. In a survey covering the farm-trade territory of Roanoke, Va., farmers were advised not to increase their production of milk, because the local market for whole milk was entirely supplied and the surplus might have to be sold at a much lower price on a butter-fat basis. Poultry raisers were shown that an increase in the local production would probably not materially affect the prices received, because poultry products were being sold in terminal mar-

kets, and that an increase in size of farm flock should prove profitable. Vegetable growers were advised of the quantity of truck crops that could be marketed in Roanoke.

In Cheshire County, N. H., where many farms have been abandoned, the production of agricultural products was found to be decreasing. The farms in that county, each with only a few acres of tillable land, have been unable to compete with western farms. It was pointed out to the owners of these farms that timber production should receive more attention and that poultry products could be doubled and still find a good local market.

Many other examples could be given, but these will suffice to show how the department is indicating neglected agricultural opportunities.

INVENTIONS BY DEPARTMENT WORKERS

Grain inspection and grading in the United States have been greatly improved and in some respects revolutionized by inventions made by members of the grain investigations staff of the department. These inventions in every case have been patented and dedicated to the people of the United States for their use without the payment of any royalties. Some of them are already employed in important grain markets throughout the world.

A public service patent was recently granted on an "aspirator" for cleaning grain at the threshing machine. When foreign matter is present in considerable quantity when the grain is marketed, it means heavy dockage. About 19,000,000 bushels of dockage was contained in the wheat and flax grain threshed in the spring-wheat States alone last year.

Another patented appliance invented in the department removes weed seeds from grain and rice which are not readily removed by the ordinary cleaning devices. Some of these weed seeds are wild oats, burr clover in barley, and watercress in rough rice.

A method has been developed in the department for the determination of moisture in grain and other substances. This moisture tester has completely changed the handling and grading of grain in all important grain markets. Its great advantage is that moisture determinations are made on the whole grain, so that there is no loss of water from the grinding of samples, and much time is saved. Without this device the grading of grain on a moisture percentage basis, as now provided in the United States grain standards act, would be practically impossible.

A grain sampler for accurately splitting samples of grain for analysis has been devised. This accuracy is essential to correct grading, otherwise the subdivisions are not representative of the whole sample.

Another of the department's inventions is the ship sampler. Under the old system of ship sampling it was the custom to grab handfuls of grain from a falling stream, or to let a bucket down into the cargo hold and allow it partly to fill up with the falling grain. These methods did not give a representative sample, and grading was therefore often very unsatisfactory. Sampling by means of the department's device takes complete cross sections from the falling grain as it leaves the delivery spout, so that the sample accurately represents the shipment.

The value of flaxseed for crushing depends largely on its oil content. The method heretofore in use for determining the oil content took about 24 hours. Recently the department developed a simple method for determining the oil content of flaxseed by which the test can be made in approximately 10 or 12 minutes. This method has already come into commercial use at the principal terminal markets in the central Northwest.

The protein content of wheat has come to be an important market factor. Practically every lot of hard red spring and hard red winter wheat arriving at terminal markets is now tested for its protein content, and substantial premiums are paid for high protein wheats. Tests are made for the grain trade at protein-testing laboratories maintained by State agencies, by commercial grain-inspection concerns, and by private chemists. Methods for making the test, and consequently the results obtained, were not uniform at the different laboratories. To overcome this the department has developed a standard method for making protein tests, the value of which is already widely recognized.

OFFICIAL GRAIN STANDARDS

Minor changes in the official grain standards of the United States for corn, oats, and rye became effective during the fiscal year ended June 30, 1925. Official grain standards of the United States for grain sorghums became effective December 1, 1924. Oat standards effective June 15, 1919, required that the grain must contain at least 75 per cent cultivated oats in order to be classified as oats. Considerable quantities of grain mixtures, consisting principally of cultivated and wild oats with varying percentages of other grains, were found to be moving in interstate and foreign commerce. This class of grain did not come within the official standards for oats established in 1919.

These products, however, have a real commercial and feeding value and are in demand not only in certain parts of the country, but also in foreign trade where a comparatively cheap feed is desired. By reason of the fact that no official standards were available for this character of feed, the merchandising thereof has been conducted on a basis of general or indefinite terms resulting in many instances in confusion and misunderstandings. After public hearings on the subject with members of the grain trade in numerous markets throughout the country it was decided to promulgate under the grain standards act, standards for grain of this kind in addition to the existing standards for oats. Accordingly, official grain standards of the United States for feed oats and mixed feed oats were promulgated and became effective September 1, 1925.

HAY STANDARDS MADE OFFICIAL

United States standards for alfalfa and alfalfa mixed hay, prairie hay, Johnson and Johnson mixed hay, and mixed hay were published, recommended, and made effective July 1, 1925. Slight revisions in the timothy, clover, and grass standards also were made effective on the same date. These standards have since been promulgated as official for the United States. Prior to their adoption,

tentative standards for alfalfa, prairie, and Johnson hay, based on laboratory data and field and market surveys, were prepared and submitted to producers, shippers, and receivers of hay at 23 public hearings held in Alabama, Texas, Arizona, California, Utah, Idaho, Washington, Oregon, Montana, Colorado, Nebraska, Kansas, Missouri, Minnesota, Michigan, and New York. Valuable suggestions brought out at these meetings were incorporated in the standards.

The commercial dry edible bean crop of the United States returns to the farmer over \$50,000,000 annually and constitutes one of the important staple food products. Quality standards uniformly applied are essential to the free interchange of this commodity in commerce. Standards are in use and applied by six regional commercial associations, each drawn up, for the most part, independently of the others. Studies of the bean industry made by the department during the fiscal years 1924 and 1925 revealed many inconsistencies in the interpretation and application of such commercial standards. Tentative standards based on these studies were prepared and issued March 1, 1925. Public hearings were afterwards held in the principal bean-producing areas, to determine wherein the standards needed revision to meet local problems. A preliminary report has been issued summarizing the results of these studies and hearings.

Tentative broom-corn standards have been prepared and recommended for the use of State and commercial organizations. These standards have been made official for Oklahoma, the largest broom-corn-producing State. A school for training inspectors was conducted at Oklahoma City, following which a joint Federal-State inspection service was established in Oklahoma.

CROP REPORTING

Information as to intended crop and livestock production, prices, stocks, shipments, demand, etc., is gathered and distributed by the department in ever-increasing volume. Three years ago a system of reports of farmers' intentions to plant crops was inaugurated. The purpose of these reports, one of which is issued in March covering spring-sown crops and one in August covering fall-sown crops, is to furnish information as to what farmers generally are intending to plant. Such information, made available at the right time, gives producers an opportunity to change their plans should there appear to be a likelihood of overplanting or underplanting any particular crop. It is believed that these intentions-to-plant reports are capable of having an immediate salutary effect on acreage and production.

The department's semiannual hog surveys, in making which the department has the assistance of the Post Office Department through rural mail carriers, have already had considerable influence on hog production. These surveys forecast production and marketing, and also indicate farmers' intentions as to breeding, thereby enabling farmers to decide when to market their hogs to best advantage, as well as whether to increase or decrease their production. Similar surveys are furnishing basic facts about dairying.

Sheep and lamb surveys likewise are made. The first of these reports has been issued. It showed a tendency to increase farm

flocks of sheep throughout the country to a point at which the increased supply would be liable to have a material effect on prices. A similar study is planned for the beef-cattle industry to throw light on the probable supply of beef cattle and to show whether there is any tendency to increase the number of beef cows for breeding.

These new lines of work were inaugurated primarily to aid the farmer in planning his planting and breeding programs, and as the work develops and is better understood the reports should exert a beneficial influence.

Constant improvement is also being made in the statistical methods used in the older and more developed lines of work having to do with crop reporting, namely, those relating to the estimating of acreage planted to various crops, the progress of the crop during the growing season, and estimates of yield and production as well as of stocks and farm prices. Material progress has been made during the past two or three years in the devising of better methods of estimating acreage. These newer methods are resulting in increased accuracy. Plans are under way to report wheat stocks much more completely than is done at present.

The cotton crop reports have recently been severely criticized, some of these criticisms being directed against the frequency of the reports, others against the accuracy of the reports, while some have gone so far as to impugn the integrity of the department officials engaged in making the reports. There is, perhaps, some ground for criticizing the frequency of these reports. The law now requires the issuance of two reports a month from July to December. The experience of the department in handling the semimonthly reports during the past two years would suggest the desirability of reducing the number of reports, especially in the early months.

The criticisms of the accuracy of the reports are largely due to a misunderstanding of the nature of the early forecasts which are often taken to be estimates of final ginnings, when, in fact, they are merely interpretative indications of condition figures reported by correspondents at given dates, and are, therefore, subject to change as prospects change throughout the season. To avoid misunderstanding with respect to these early forecasts, it has been suggested that the cotton forecasts during July and August be omitted, the department simply reporting the acreage in cultivation and the condition and progress of the crop during these months, and that, beginning in September, forecasts be made which, instead of being stated as a single definite figure as at present, be issued in the form of a range forecast, which would indicate the probable upper and lower limits within which the final ginnings were likely to fall. It is believed that if these suggestions were carried out some of the present criticism might be avoided without diminishing in any way the value of the official cotton reports.

The crop reports covering crops other than cotton are quite generally accepted by producers and the trade as the best available and are seldom subject to attack. The cotton reports, notwithstanding the frequent attacks upon them, are generally accepted as more accurate than those issued by private estimators, of which there are now more than a score.

RADIO AND THE FARMER

The department made its first experiment with radio in 1920. Since then there has been a great development in the use by farmers of this new means of communication. A survey made by county agricultural agents in 1923 indicated there were about 145,000 radio sets on farms throughout the country. In 1924 the estimated number had jumped to 365,000 and in 1925 to 553,000. The average number of radio sets on farms per county has increased from 51 in 1923 to 204 in 1925. This increase of 300 per cent is evidence that the farmer appreciates the broadcasting service provided for him.

There has also been rapid growth in the number of radio-receiving sets on farms in States at great distances from good broadcasting service. In Florida, for example, the increase in 1925 over the estimated number on farms in that State in the preceding year was 1,955 per cent. Idaho increased the number of its farm receiving sets 850 per cent in the year, Alabama reported an increase of 850 per cent, Arizona of 460 per cent, and Louisiana of 600 per cent. In Pennsylvania, on the other hand, the gain in 1925 over 1924 was only 5 per cent.

Farmers generally have bought very good radio sets. A questionnaire answered by 2,500 farmers in 1923 indicated the average price of their manufactured sets was \$175. This sum will buy a better set to-day than it would two years ago. Yet farmers are not on that account reducing their investments in radio. Dealers in several parts of the country say that radio sets worth from \$125 to \$400 sell much more readily to farmers than those costing under \$100. Farmers have discovered that they need good long-distance sets to get the weather and market reports and entertainment they demand. Twenty-four agricultural colleges maintain radio broadcasting stations. The colleges are becoming enthusiastic users of radio. They cooperate with the Department of Agriculture in broadcasting its weather, crop, and market reports. Several hundred broadcasting stations regularly obtain information for broadcasting from the department. Many farmers have more than saved the price of their radio sets by profit gained by the use of market information issued by the department for broadcasting.

THE LIBRARY

A comprehensive collection of books and periodicals, bulletins, and reports relative to practical agriculture, agricultural statistics, and scientific experimentation at home and abroad is a necessity for the department. In the field of agriculture and the related sciences, the library stands unsurpassed by any other single collection. It now contains 180,000 books and periodicals. Many of these are found in few, if any, other libraries in the country. The collections have been enriched during the last year by the addition of over 13,000 volumes and pamphlets. The periodical list is growing fast. Publications of the department are widely distributed to agricultural officials, societies, colleges, universities, and other institutions of learning. In return for these, thousands of serial publications are obtained. There are currently received by the library

more than 4,000 periodicals, of which number about two-thirds come by gift or exchange. The files of agricultural papers include representative publications from all over the world.

Agricultural workers, particularly those connected with the land-grant colleges and the agricultural experiment stations, look to the library of the department for books and for verification of references. Books are sent to every State in the Union. In the last 10 years the number of books lent has increased 100 per cent. Last year 1,916 books were lent to institutions outside of Washington. The dictionary catalogue of the library now numbers a half million cards, and is supplemented by special indexes in the bureau libraries on the subjects in which the bureaus specialize. All of these catalogues and indexes make an invaluable key to the literature of agriculture and the related sciences, and are in constant use in supplying information on the subjects of investigation by the department.

THE NAVAL STORES ACT

The naval stores act of March 3, 1923, is designed to improve the quality and the accurate grading of rosin and turpentine and to prevent the misbranding of these products when shipped into interstate or foreign commerce. The personnel for the enforcement of the act was organized during the year and a number of cases involving violations of the act instituted. Samples from 215 shipments of turpentine have been collected and examined during the year and 35 citations to hearing were issued. Under the service features of the naval stores act approximately 20,000 round barrels of rosin have been officially inspected, graded, and official United States grading certificates have been issued to cover them.

HOME ECONOMICS

National welfare is based upon the combination of efficient production and wise consumption. The second of these two essentials, long neglected, is now beginning to receive the attention it deserves. The direction of home expenditure along lines which will make for health and well-being is the work of the department's Bureau of Home Economics. Studies are necessary to furnish information about the American diet. It is not enough to know what people consume. Certain items of the consumer's budget, notably food, may fall short of requirements for health and efficiency. Estimates of the food needs of the consumer should take such a discrepancy into account. Determination of requirements for an adequate standard of living therefore forms an important field of study. But if adequate standards of living are to be made effective, current practices must be checked against ideal standards.

In each of these fields of investigation much research is still to be done. For the last three years the department has been conducting an investigation in farm standards of living. During the last year the results from two States have been summarized. Analysis of the food expenditures of 3,000 farm families has been started in the light of present standards for adequate nutrition.

Methods of food preservation are important factors in wise utilization of food in the rural home. As a result of studies in this bureau and in the Bureau of Plant Industry the department has

withdrawn from distribution all previous publications on home canning and issued a circular giving directions for home canning based on the results of the research of these two bureaus. Special attention is called to the use of the pressure cooker in canning nonacid vegetables, to the use of the "hot pack" for both fruits and vegetables, and to the careful examination of canned foods before use. Various questions are being investigated, so that a more definite stand may be taken on certain controversial questions in home canning.

VI. DEPARTMENT OF AGRICULTURE: ANIMAL HUSBANDRY AND PLANT INDUSTRY INVESTIGATIONS

FUNDAMENTAL DAIRY RESEARCH

To carry out the policy of enlarging the work in fundamental dairy research it was necessary to readjust the department's activities by cutting down the force devoted to cooperative work in the States so as to make it possible to undertake new investigations without additional funds. Work on the scientific principles governing the nutrition of dairy cows was considerably enlarged. The new building for research in nutrition was put into use and has greatly facilitated this important study.

On account of the large amount of calcium (or lime) in milk, heavy-milking cows require a great deal of it in their feed. Experiments have been conducted which show that if heavy milkers do not get sufficient calcium in their feed they will take it from the reserve supply in their bones in order to put it into the milk. This drain on the cow's body has a serious effect on her health and ultimately reduces her capacity for milk production and the bringing forth of normal, well-developed offspring. Dairy cows are more liable to suffer from a deficiency of calcium in their rations than from a lack of any other feed constituent so far studied.

It has also been found that calcium taken into the cow's stomach in various kinds of feed is assimilated into body tissue and milk with different degrees of readiness. The assimilation of calcium from such calcium compounds as ground rock phosphate, ground limestone, and bone meal has also been studied a good deal, and it has been found to be much lower than that from either alfalfa or timothy hay.

The quantity of phosphorus contained in the diet has an important effect on calcium assimilation. If a milking cow receives a diet which contains sufficient assimilable calcium, but not enough phosphorus, she will at first take phosphorus from her soft tissues to put into the milk; but the phosphorus which can be spared from the soft tissues is small in amount, and it is soon used up. When this has happened, the cow then begins to take phosphorus from her bones. The chemical composition of the bones is not easily changed; therefore, when phosphorus is taken from them, calcium comes along with it in the proportion of two parts by weight to one of phosphorus. Calcium coming from the bones in this way, and not used for milk secretion, is lost in the manure. Thus a cow may lose calcium from her body on account of a shortage of phosphorus in her diet.

Cows which receive too little calcium or phosphorus in their rations go down in their milk yield, and finally come to grief in one way or another, just as surely as cows which receive too little general nourishment. The difference is that in the latter case the cow gets thin, and anyone can see what is the matter with her as soon as he looks at her; whereas in the former case she may appear to be in very good condition, and the cause of the trouble can be discerned only by rather difficult and expensive investigations.

Farmers and dairy investigators generally recognize the fact that one of the quickest ways of increasing the net income from dairy farms is to have cattle that will produce more milk and butterfat than the average cow does at the present time. The average production of the cows of the United States is much too low. In round numbers it is about 180 pounds of butterfat a year. This can be increased, no doubt, in two ways: (1) By feeding our present cows better; (2) by raising the hereditary level of the producing capacity of our dairy cattle by better breeding. Both of these phases of the problem are being carefully studied by the department.

Breeding experiments are under way involving 1,500 head of dairy cattle in various parts of the United States. The object is to determine the method of breeding that will insure uniformity in the transmission of the capacity for high production of milk and butterfat. The methods of mating that are being compared are line breeding with outbreeding and inbreeding with outbreeding. With these goes the continuous use for generation after generation of sires that have proved their ability to transmit uniformly high-producing capacity to their offspring.

As a result of production studies made with the records of animals in the Advanced Register and Register of Merit, the theory has been advanced that a sire's hereditary make-up for producing capacity is indicated by the production records of a number of his daughters more accurately than a cow's hereditary make-up for producing capacity is indicated by her individual production record; that where all the daughters of a sire are uniformly excellent producers, this may be taken to indicate that such a sire has in his hereditary make-up only those factors that determine high-producing capacity, and therefore he is pure (or homozygous) for the factors controlling high-producing capacity; and finally, that by the use of such sires for generation after generation, dairy cattle might be bred that in the course of five or six generations will have an inheritance that will make it possible for all of them to be high producers, and that will make it impossible for them to transmit to their offspring an inheritance for low-producing capacity.

The difficulty is to find these pure sires. Up to this time we have looked to the Advanced Registry and Register of Merit to prove our sires. The difficulty in the selection of a proved sire through official testing is that the poor daughters of a sire may not be tested, because of the requirements for entry into the Advanced Registry or Register of Merit, and also for commercial reasons.

In the cow-testing association this difficulty may be largely overcome because it is the practice to test the entire herd, including the good and the poor daughters of a sire. Heretofore, the proving out of the thousands of well-bred sires in use in cow-testing associations

in this country has not been emphasized. The department is now taking steps to secure the necessary data to measure accurately the transmitting ability of the sires in use in cow-testing associations

MILK-PLANT MANAGEMENT

In order that the milk producer may get a good price for his product without at the same time forcing the consumer to pay an unduly high price, it is necessary for the city milk distributor to operate his business at as small a cost as possible. Investigations are being carried on to determine the best practices in milk-plant operation, both from the standpoint of economy of plant operation and of quality of the product. Labor studies have been made at 125 milk plants located in the principal cities of the East. A detailed study is made at each plant, the number of men and time required for each operation being determined. The results of these studies indicate the most desirable arrangement and layout of plants and equipment.

The cream layer visible on a bottle of milk is the principal means which the consumer has for judging the richness or butterfat content of the product. Investigations have been carried on to determine what processes in the milk plant have a tendency to injure this visible cream layer and what methods may be followed for procuring the normal and uniform cream layer and at the same time obtain a clean and safe product.

Studies are being carried on at country milk stations to determine the most economical methods followed in the construction, arrangement, equipment, and operation of these stations in order to assist milk producers and dealers in establishing and remodeling such stations.

RUBBER POSSIBILITIES IN THE UNITED STATES

On account of rapidly advancing prices there is an acute demand for information regarding rubber-production possibilities in the United States and in tropical America. It is believed by many industrial and economic writers that a serious shortage in the supplies of crude rubber is impending, in addition to the dangers that have been recognized in being dependent upon the East Indies for a product that within a few years has become indispensable not only for industrial purposes but for military requirements. About three times as much rubber is used in the United States as in all the rest of the world. Rubber is now as essential to agricultural production and marketing of crops as to the urban industries. The present development of our civilization could hardly be maintained without rubber.

Interest in the possibilities of rubber production is intensified by the large areas of unused or partially used land in the United States, especially in the southern and southwestern regions, where rubber production might be feasible if suitable plants were discovered and methods of utilization were devised.

It has been determined already that several of the rubber-producing plants grow well under our conditions, and could be utilized, but other species or varieties may be found that yield more or better rubber, or are better adapted to cultivation under our conditions.

Because of the large numbers of plants that contain rubber, it is a large undertaking to make experimental determinations of the various possibilities that exist, in order to settle upon the plants that are best adapted to our conditions, and to develop suitable cultural methods and extraction processes.

Investigations of the problems of rubber production are being based on a new principle or method of procedure. Attention is first given to the cultural characters of the plants, so that intensive technological investigations of extraction and utilization methods may be directed to the species that are most readily propagated and that afford the best assurance of production in large quantities. In this way the investigation of agricultural possibilities will not be restricted to the species that have served as commercial sources of rubber, since the agricultural possibilities obviously do not depend upon the abundance of a plant in the wild state, or upon the exploitation of its natural products. Some of the most important crop plants are not known in the wild state or exist only in limited numbers under restricted conditions.

Several of the tropical rubber-producing species thrive and appear well adapted to conditions in southern Florida. Although the East Indian plantation system of production apparently would not be feasible in Florida on account of the high cost of labor, it is not impossible that other systems and methods of production and extraction of the rubber may be developed that could be established as regular agricultural industries. Popular interest in such possibilities of tropical development in southern Florida is very acute among the thousands of new settlers who are now establishing themselves in the more tropical districts. Although private cooperation may contribute to earlier solutions of the experimental problems, commercial plantings of rubber can not be considered advisable until practical methods of handling the crop under the Florida conditions have been devised and demonstrated.

Rubber plants that are natives of dry regions are being tested in California. Special attention is being given to one of the native species of milkweed (*Asclepias subulata*), which appears to be the most promising from the standpoint of growing on waste lands and of producing the largest quantity of rubber-bearing material readily and cheaply.

The East Indian tapping methods have been applied experimentally to a small planting of hevea, about 20 years old, near the north coast of Haiti. The records of these experiments are comparable with those that have been reported from the East Indies and show the same wide range of variation in the production of latex from individual trees. From 60 per cent to 75 per cent of the rubber is produced by 25 per cent of the trees in the East Indian plantations, and the problem of producing uniform high-yielding trees is still to be solved. Some of the trees in Haiti approached the best records in the East Indies, whereas other trees produced very little latex and some none at all. Owing to the seasonal variation in the flow of rubber being much greater in Haiti than in the East Indian plantations, other systems of production should be considered in which continuous tapping would not be necessary.

Plantings of all available species of rubber plants are being made in the Canal Zone in cooperation with the experimental garden of the Canal Zone at Summit, near the middle of the isthmus. By permission of the War Department a tract of 10 acres on the Atlantic side of the isthmus, at the Fort Sherman Military Reservation, has been made available for experimental plantings of rubber. These plantings are on lands that are being drained to control mosquitoes and that afford conditions apparently quite similar to those of the locality where hevea rubber has thrived in Haiti. From seed beds to be established in these or in other suitable places it is expected that seedlings of hevea can be transplanted at least in small numbers to many localities that can be selected to represent the full range of conditions in the Canal Zone and adjacent districts of Panama, to determine the practicability of commercial plantings of rubber or of utilizing waste lands for reserve plantings from which emergency supplies could be drawn.

IMPROVEMENTS IN COTTON PRODUCTION

Intensive studies of the problems of cotton production in the United States since the boll-weevil invasion have shown several causes of gradual deterioration in the quality of the fiber and lower yields per acre that have no necessary relation to boll-weevil injury, although they have frequently developed seriously in the same regions where boll-weevil injury has been serious.

The planting of seed of several different varieties of cotton in the same neighborhood, the intercrossing of these varieties in the fields, the mixing of the seed at the public gins, and the general use of gin-run seed for planting, are especially important causes of deterioration.

The production of poor fiber and low acre yields from mongrelized gin-run seed has been the underlying reason for the popular idea that cotton varieties "run out" and that fresh seed must be brought in every few years from other districts. It has been shown, however, by careful and extensive experiments that selected seed stocks that have not been allowed to become mixed may be grown continuously in the same districts for many years with no indication of "running out."

Wider utilization of superior varieties is going forward more rapidly through a plan of organizing one-variety cotton communities as centers of seed supplies where supplies of pure seed are grown, sufficient for general planting in the region, and where uniform high-quality cotton is produced in the commercial quantities that manufacturers require.

As compared with the usual conditions of mixed-variety production, each individual farmer of a one-variety community is able to raise more cotton and of better quality, which can be sold at a higher price. The manufacturers are willing to pay more for dependable supplies of uniform fiber because the spinning and weaving are less expensive and the resulting fabrics are better. The advantages to be expected eventually through establishing and maintaining a system of community production and marketing of the

crop of Acala cotton in the single-variety communities may be estimated conservatively at from 3 to 10 cents per pound, or from \$15 to \$50 per bale.

The organization of one-variety communities is of interest in other States not only as a step in working out the general problems of the cotton industry but as assuring a source of seed supply of good varieties that may be drawn upon in emergency years.

In California the State legislature recently passed an act which definitely excludes other varieties of cotton from specified districts where the farmers have restricted themselves to the Acala variety. The purpose of the enactment, to protect the public interest in the improvement of the cotton industry, is clearly stated in the first section of the act, and is regarded as in line with well-established precedents. No extra cost is involved in establishing the one-variety improvement, but only the requirement that growers refrain from injuring their neighbors who have adopted an improved system of production. The cotton land becomes more valuable in a restricted community, because it can be used with greater advantage to the farmer.

In the last few years a number of superior varieties of cotton have been developed by the Bureau of Plant Industry, better adapted to purposes of production under weevil conditions, maturing earlier and larger crops, and producing fiber of better quality. Among the more prominent of these are the Acala, Lone Star, and the Pima variety of Egyptian cotton grown in the Salt River Valley of Arizona. Hundreds of thousands of acres have been planted with these varieties and crops of aggregate values of many millions of dollars produced, as well as a general stimulation of interest in better varieties and better seed.

The production of cotton is also being improved by the application of new cultural methods, based on the discovery that the restriction of the size of the plants will shorten the growing season and often will greatly increase the yields in the presence of the boll weevil, and under short-season conditions along the northern rim of the Cotton Belt. Leaving the plants closer together in the rows increased the yield 50 per cent or more in some test cases, and a general estimate of at least 10 or 15 per cent would be justified to illustrate the value of this improvement.

DRY-LAND AGRICULTURE

The hazard of agricultural production in the Great Plains is only partially the crop hazard owing to unfavorable weather and soil conditions, insects, diseases, and other pests. The temptation to expand any agricultural enterprise to the extreme limit of financial credit has often led to unnecessary disaster. With a better balanced agriculture and a more careful provision for reserve credit, or, in other words, a more conservative development of any area in the Great Plains, the substitution of a sound and reasonably profitable agriculture for much of the speculative enterprises of this area is assured.

During the past three years the possibilities of home making in the Great Plains have been brought more closely to the attention of farmers than any other phase of agriculture in that region. Once

it is demonstrated that the maintenance of self-sustaining homesteads is not only possible but practicable in that vast region, the results can not but be beneficial and far-reaching.

The work of the department with that objective in view has been productive of encouraging results and has reached the stage to justify the conclusion that homes can be established and families maintained from the returns of fruits and vegetables of the farm under all growing conditions. Upon a 1-acre plat sufficient vegetables can be raised to support a family of five. These fruit and vegetable results are significant. It means that the food requirement of a family is assured from the farmstead. Add to such a farmstead a cow or two, a litter of pigs, and a flock of poultry, and a competent farm economy is accomplished.

The attractive and happy farmsteads provided with these resources that are beginning to dot the prairies in the Plains region fully compensate for the years of labor by the investigators of the department and augur well for the future. Any permanent agriculture must plant its roots around the nucleus of the farm home. When communities of farm homes are once established, the expansion of farm activities for supplying staple crops for the market on a large scale will develop as the capital of each farmer increases and experience guides his industry and initiative.

BARBERRY ERADICATION

The campaign to remove all of the common barberries in the 13 north-central grain-growing States has completed its seventh full year. The State agricultural colleges of the 13 States, the State departments of agriculture in most of the States, the conference for the prevention of grain rust, and similar allied agricultural and business organizations are cooperating in the campaign. There are four phases of the campaign: Investigation, publicity, survey, and eradication.

Numerous foreign and native species of barberries and hybrid barberries have been added to the *Berberis* garden at Bell, Md., during the year. These are being assembled for description and classification. Native species of barberries also are being studied in their natural habitat and the most effective method of eradication of the susceptible species is being determined.

Additional proof of the connection between common barberries and rust in grain has been obtained. Aecidiospores developed on common barberries within the eradication area about a month before the appearance of stem rust on grains and grasses. Grains and grasses near infected barberries became rusted two or three weeks before any rust appeared on more distant grains and grasses. A heavy rust infection on spring wheat in central North Dakota in 1924 was immediately traceable to about 80 barberry bushes near Jamestown, which had been overlooked in an original survey. The occurrence of stem rust on oats over an area more than 60 miles long in western Wisconsin was directly traceable to infected barberries in the area of escaped bushes near Trempealeau.

Before the removal of great numbers of barberries it was nearly impossible to differentiate between the local stem-rust epidemics which the infected barberries caused. Now that many millions of

these bushes have been removed, the local epidemics are greatly reduced in number and are more easily identified. Within the last year it has been possible to find barberry bushes by tracing stem-rust epidemics from areas of light infection to areas of heavier infection until the source of the epidemic was reached. This has been true in practically every State of the eradication area.

It seems very probable that when the barberry in the 13 States is reduced to such a minimum that each local epidemic can be clearly isolated from the other epidemics each common barberry eventually will reveal its location in a year favorable to the production and spread of stem rust. Barberry eradication has been especially emphasized through the schools. With the cooperation of Smith-Hughes instructors and school superintendents and teachers, many school children have been taught to identify the harmless Japanese barberry, the harmful common barberry, and the different stages of black stem rust.

After several years of experimenting with nearly 40 different chemicals it has been demonstrated that common crushed rock salt and kerosene are the two most satisfactory chemicals with which to kill a common barberry. The use of sodium arsenite, which for a time was recommended, has been discontinued because of the danger to livestock involved in its use. Either salt or kerosene is 100 per cent effective if properly applied, and the cost of application is considerably cheaper than eradication by digging. The availability of both salt and kerosene makes them especially satisfactory. During the fiscal year 304.5 tons of salt and 11,957 gallons of kerosene were used to kill 427,914 barberry bushes, sprouting bushes, and seedlings on 2,651 properties.

A determined effort has been made to discover and treat all escaped barberries. One of the outstanding discoveries of the year's work is the fact that areas of escaped bushes in nearly every instance are larger than was at first supposed. It has been necessary to survey miles in every direction from hedges of barberries which are bearing seed. Where the escaped bushes are fruiting, the policy is to survey foot by foot at least 2 miles beyond the limit of the last fruiting escaped bush. Seedlings still continue to appear every spring around hedges which were destroyed several years ago, indicating that seeds lying on the surface of the ground will retain their viability for as long as six or seven years. A total of 3,860,402 escaped bushes and 4,631,929 seedlings have been found to date. Of these 259,733 escaped bushes and 806,451 seedlings have been found this year.

EFFECTS OF CROPS ON THE YIELDS OF ROTATION CROPS

Fairly extensive field tests, the technical description of which will be published soon, have demonstrated the fact that use of intensive cropping systems may quickly cause some soils to lose the power to produce satisfactory yields of certain crops. Liberal fertilizing and manuring may hasten rather than delay or prevent the development of this condition. In the crops involved the root system may fail to develop normally in spite of the fact that some of the soils behaving in this manner are in excellent mechanical condition and have very thorough underdrainage. This condition does not involve loss

in general productiveness, for some crops give excellent yields, whereas others are more or less complete failures.

It has been found that the cropping system largely controls the situation and the result in any particular case primarily depends on the comparative effect of the preceding crop in producing the unfavorable soil condition, on the one hand, and the sensitiveness of the succeeding crop to this condition on the other hand.

Corn seems to be a crop which is especially apt to affect succeeding crops in the rotation unfavorably, but itself is not sensitive to the effects of other crops. The converse is true of tobacco. Systematic crop rotation, with free use of soil-improving crops, does not necessarily correct or improve this condition of the soil. In the case of tobacco no system of rotation has been found which fully equals the simple expedient of allowing the soil to remain idle and undisturbed for a year or more, with or without a covering of adventitious vegetation. Curiously enough, the next best results are obtained with tobacco in continuous culture, without use of any soil-improving crop, or after crop plants related to tobacco, such as tomatoes and potatoes, which also are sensitive to the soil condition in question. On the other hand, tobacco may give poor results after crops to which it is in no way related, such as corn, grasses, and legumes. Similarly, potatoes give much better results after tobacco than after corn. Among the legumes, soy beans affect tobacco very unfavorably when compared with cowpeas, whereas both legumes are very beneficial to corn. It is apparent that these specific crop effects are explainable only in part on the basis of the quantities of plant nutrients removed from the soil. The fertilizer treatment may modify but frequently does not control the effect of one crop on another. Weather conditions, more particularly the seasonal rainfall, have been found to exert a marked influence in these crop effects.

WHITE PINE BLISTER-RUST CONTROL

The white or five-needled pines of this country are of outstanding importance in the development of forestry. Of the nine species occurring in the United States, the eastern white pine, western white pine, and sugar pine are of great commercial importance and value. Existing stands of these trees on public and private lands approximate 80,000,000,000 board feet, having a stumpage value of about \$550,000,000. Their harvesting and utilization sustain many industries and give employment to thousands of people. Immature stands of these species cover large areas of forest land and form a most important part of the forests of the future. The intrinsic value of their wood, their rapid growth, their wide range, and their adaptability to forest management give them a commanding place in the forestry of this country. The continued maintenance of these species in our forests is a matter of regional and national concern.

In the eastern United States the disease has been present about 25 years, although it was not known to be widely established on native pine until 1916. Since then control measures have been developed and demonstrated by extensive field tests to be practicable and effective. A control program, requiring an estimated period of eight years for completion is now under way in cooperation with

the affected States. Such action is necessary to prevent serious losses in maturing stands and to assure stability in the continued production of the pine crop.

The control program has made good progress and public interest and cooperation in the work have been very satisfactory. Each year numerous individuals and many townships have joined in the co-operative work, and control measures have been applied on 3,447,485 acres of land.

In the West a 10-year control program in cooperation with the States concerned has been vigorously prosecuted. Apparently the disease was introduced from France into British Columbia about 1910 and became thoroughly established on native host plants before its discovery in 1921. It has spread into eastern British Columbia to within 35 miles of the white-pine region of Washington and Idaho, and to the south it has extended its range through western Washington to the Columbia River. No further extension of the disease was found in 1924. This probably was due primarily to the dry weather conditions that prevailed in the Northwest and to the extensive eradication of cultivated black currants. Additional pine infections were found in western Washington, indicating that the rust is beginning to establish itself on the native pine host in that region.

Cultivated black currants (*Ribes nigrum*) have been systematically located and eradicated in western Montana, Idaho, Washington, Oregon, and northern California. This species of currant becomes diseased at great distances from infected pines and establishes new disease centers from which the rust spreads locally to other currants and gooseberries and to white pines. The department recognizes this currant as a distinct menace to the white-pine timber supply of the country and is opposed to its growth in the United States. Some States have declared it a public nuisance and prohibited its further culture.

CITRUS CANKER ERADICATION

As a result of the vigorous campaign conducted by the Gulf States in cooperation with the department, citrus canker, a bacterial disease of citrus fruits and trees, has been practically eliminated from the greater portion of this region. Mississippi has not reported any new infection since November, 1922, and, apparently, is free from canker. The work in Alabama has been very effective. The last infection found there was in June, 1924. Florida reported the discovery in March, 1925, of five infected trees on two town lots at Boynton. All citrus trees on these properties were destroyed and a rigid inspection of the entire district was conducted, but no more infected trees were found. With this exception, Florida has been free from canker since October, 1923. In Texas the work has progressed satisfactorily. No new infections have been reported.

Scattered infections of nursery stock are being found in Louisiana. During the past year major efforts have been devoted to citrus properties in Terrebonne and Lafourche Parishes, where all trees were uprooted from properties where citrus canker had been found. New trees were planted under permit to prevent owners from planting trees in the same soil or in close proximity to soil from which canker-infected trees were removed. Because of scattered infections

in dooryard plantings in Louisiana and the possibility of similar infections occurring sporadically in other States, it will be necessary to maintain at least a reconnaissance inspection of the entire citrus area for several years.

SUGAR-CANE INVESTIGATIONS

Despite the disastrous flood which occurred at the field station at Canal Point, Fla., in October, 1924, a number of new sugar-cane seedlings were produced, and about 300 of them survived. These are all from parents which are immune to or tolerant of mosaic, a disease which is responsible for much curtailment of sugar-cane yields in Louisiana. Approximately 1,300 seedlings produced at the station in previous years were given preliminary trials, and a large proportion of them have been discarded. About 500 promising ones were sent to our field stations at Cairo, Ga., and Houma, La., for further trial. Performance records of about 5,000 sugar-cane seedlings in various stages of testing are now on hand. In addition to the seedlings many standard varieties imported from foreign countries are being tested at Canal Point.

Imported varieties of sugar cane and seedlings from Canal Point were tested at this station. One of the varieties proved decidedly better than the "native" varieties, and was distributed to nearly 3,000 planters in the Gulf States. Our field men also supervised the distribution by the American Sugar Cane League of 52 half-ton lots of the same seed cane. The department's work in importing, testing, and distributing this variety, which is extremely resistant to mosaic and root disease, should have very beneficial results.

SUGAR-BEET INVESTIGATIONS

A study of different sugar-beet areas of the United States shows that in some regions development of effective fertilizer practices, together with modern field operations, will assure satisfactory production. In other regions pests and diseases appear to be the essential limiting factors. Among the more important of these troubles is the sugar-beet nematode. The efficiency of economic rotation systems for controlling the sugar-beet nematode has been established and from the experience gained it would appear that areas of heavy infestation should be readily controlled and serious future losses from this cause avoided.

Perhaps the most important single factor limiting sugar-beet production in the western areas is the curly-top disease, caused by the virus transmitted from diseased to healthy beets by the sugar-beet leafhopper. Important technical discoveries regarding this disease have been made during the last year, although the exact nature of the virus still remains undiscovered and no method of destroying either the virus or the leafhopper has as yet been found.

Observations made in various sugar-beet growing areas in the States west of the Rocky Mountains revealed striking contrasts between different localities in the amount of curly top occurring. In southern California there was more curly top in 1925 than has occurred in the eight years during which the fields have been observed.

On the other hand, the prospects for a beet crop in the intermountain region were the most favorable in a number of years.

In the Yakima Valley of Washington last season approximately only 25 per cent of a normal crop was harvested from a large acreage. The losses from curly top in this valley have been so serious and frequent in occurrence that by 1925 beet growing had been practically abandoned. Three fields, comprising only about 20 acres, were planted. In southern Idaho, where last season more than 10,000 acres were ruined by curly top, the 1925 crop was in excellent condition. In Utah there was this year relatively little curly-top damage, whereas the only previously recorded outbreak of curly top in Utah which can be compared in seriousness with that of 1924 occurred in 1905.

The most encouraging phase of the recent work is the slightly greater resistance to the disease shown by some strains developed by specialists engaged in breeding beets for disease resistance. Although these strains are not sufficiently disease resistant to be of commercial importance, even this much gain in the knowledge of combating the disease is noteworthy, and accordingly the department has undertaken a thorough exploration of the native home of the sugar beet in the hope of there discovering more resistant types which can be used for intensive development of the work of breeding for disease resistance.

RED-CLOVER SEED PRODUCTION

Red clover is by far the best restorative crop in Corn Belt rotations. The steady decline of the red-clover acreage over a long period has adversely affected the yields of all other crops involved in the rotation. For at least 15 years the United States has been a heavy importer of red-clover seed. Most of this seed has come from Italy and southern France. Evidence is accumulating to show that much of this imported seed is not satisfactory for use in America. Cooperative trials which the department has been carrying on with experiment stations in the Middle West have shown that the plants from imported seed are much more likely to winterkill than those from American seed; that they are more susceptible to certain diseases, and that they often give a smaller crop even when the stand is otherwise apparently satisfactory.

As far as our investigations have progressed we have found that Italian seed is everywhere unsatisfactory and that French and Chilean seed, although giving good yields in some parts, is unsatisfactory in Iowa, Minnesota, and elsewhere where the winters are severe. During the past year there has been a considerable development of the cooperative movement in the purchase and sale of red-clover seed. Those most active in this movement insist on the condemnation of all imported seed and the use of the United States grown seed only. With the present limited production in the United States the American farmer can not confine himself to domestic seed, and the importation of something like 12,000,000 to 15,000,000 pounds annually is necessary.

The fact has developed that red-clover seed may produce plants unsatisfactory to the American farmer either because they are not resistant to cold or are not resistant to disease. It has been custom-

ary in the past to call every case where clover died out during the winter a case of winterkilling. The department has learned, however, that in the region approximately south of the Potomac and the Ohio, winterkilling due to freezing or freezing and thawing is a rare phenomenon, but that most of the destruction of the clover in that area is caused by anthracnose. Just how far this disease is serious is not known, but this phase of the work is being studied. It is known, however, that plants raised from Italian seed are extremely susceptible and that plants from European and South American sources vary in susceptibility, some lots suffering very heavily and other lots scarcely at all. We also know that seed from certain parts of the United States will produce plants which, in the area where the disease is severe, will suffer as much as French or Chilean plants, whereas seed from other sections appears to produce plants with a high degree of resistance.

FIELD TESTS OF IMPORTED ALFALFA SEED

The tendency to increase the acreage of alfalfa, particularly east of the Mississippi River, is now very marked. This tendency has resulted in very large increased demands for alfalfa seed. Our domestic supply has rarely, if ever, been adequate for home needs. In the past two or three years the supply has not nearly kept pace with home consumption and has resulted in the importation of considerable quantities of seed from foreign sources, particularly Argentina and South Africa. This seed has been sown very generally in the eastern part of the United States, regardless of latitude. Although the seed from Argentina, according to the preliminary tests that have been made by the department, gives very satisfactory results as far north as central Pennsylvania, it does not appear to be sufficiently hardy north of this line to be dependable. On the other hand, the seed from South Africa, according to the preliminary tests, which are not nearly as extensive as those made with seed from South America, does not appear to be particularly well suited to any part of the United States where alfalfa is grown.

VII. DEPARTMENT OF AGRICULTURE: SCIENTIFIC AND EXTENSION WORK

EXTENSION SERVICE

The past year marked the beginning of the second decade of co-operative extension work between the department and the State agricultural colleges under the Smith-Lever Act. It saw the further rounding out of this national system of education among American farm people and their increased participation in planning and applying it to the needs of their local communities. More than 180,000 farmers and farm women acting as volunteer leaders joined with the paid extension forces in undertaking to improve agricultural and home practices. Farmers and farm women themselves were encouraged to explain the demonstrations, conduct the meetings, make reports, write necessary letters, explain extension work, and solicit support for it. Self-conducted demonstration was a basis for this teaching. More than a million demonstrations influencing farm and home practices were carried to completion during the

year. Of these demonstrations 645,000 were conducted by adults and 489,000 by farm boys and girls. This increased participation in extension activities by farm people has markedly stimulated thought and resulting action looking toward better farming methods, higher standards of living, and a more attractive farm life.

The total forces employed in cooperative extension work in the States during the year numbered 4,868 persons. Of that number 3,455 were located in the counties, and of these 2,171 were engaged in county agricultural agent work, 880 in home-demonstration work, 133 in boys' and girls' club activities, and 271 in extension work with negroes. There were in addition 723 full-time and 207 part-time subject-matter specialists with headquarters at the State agricultural colleges supplementing the work of the county agricultural agents. Supervisors, assistant supervisors, and administrative officers numbered 483. Public agencies continued to take over an increased part of the financing of county extension work, with a consequent gradual decline of funds from private sources. This trend further stabilized the status of extension work in the counties.

State and regional programs for farm and home improvement were developed during the year. The Northeastern and far Western States, in particular, worked out sectional programs based on carefully selected economic data. In formulating these programs chief consideration was given to their effect on the fundamental agricultural enterprises of the States involved. At the conference of extension workers in the Western States held at Tucson, Ariz., in November, 1924, recommendations were adopted covering the production of alfalfa, corn, and barley in relation to the range livestock and dairy program; home gardening and fruits in relation to the human-nutrition program; and potatoes and wheat as cash crops.

The nutrition specialists, meeting in connection with the extension conference of the Northeastern States in New York City in February, 1925, developed a sound basic program for extension work in nutrition, involving particularly food selection, preparation, preservation, the food budget, prenatal and postnatal nutrition of the mother and nutrition of the infant, the preschool child and the school child. The program contemplates training schools in subject matter for extension agents, use of well-trained local leaders, improvement of demonstrations and development of the growth work in connection with boys' and girls' club projects based on the idea that the club member should be his own best exhibit.

EXHIBITS AND MOTION PICTURES

Marked progress was made in the effectiveness of the department's exhibits at fairs, particularly at the National Dairy Show and the International Livestock Exposition. At the latter a feature which created much interest portrayed the contrast between common and good beef cattle, with live animals of the two classes as calves, feeders, and finished steers. Samples of the principal cuts of meat from good and from common steers were also shown. The exhibits were accompanied by appropriate backgrounds and legends pointing out the difference in the two classes and the better financial returns from the good steers. Showings were made by the department at 86 fairs, expositions, or other gatherings.

During the year, 28 new educational motion pictures were completed and 30 old films were revised. The department now has a film library of 1,862 reels available for distribution, consisting of from 1 to 50 copies of more than 200 different pictures. Shipments of films to cooperative users numbered 4,260, an increase of 33 per cent over the previous year and double the number made in 1923. Actual attendance at showings of department films totaled nearly 3,000,000. Conservative estimates of attendance at showings not reported and of films purchased by State extension services and other agencies indicate that 9,000,000 persons saw department films during the year.

BROADCASTING WEATHER FORECASTS

At the close of the year there were 121 stations, located in 40 different States, broadcasting weather forecasts and information by the radiophone on regular schedules. About 95 per cent of all the powerful radiophone-broadcasting stations in the United States are now cooperating and many of them broadcast forecasts for several States, and people in every section of the country are being served. The scope of the radiophone weather service may be estimated when it is known that, for instance, in the State of Iowa alone there are over 33,500 receiving sets *on farms*. It is estimated that the weather forecasts are available by radio to more than half a million farms in the United States.

An outstanding feature of the Weather Bureau's work last year was the warning given citrus growers the latter part of December of the approaching period of cold weather of unusual length and severity. On this information an additional 300 carloads and 175 truck loads of oil were rushed into the citrus districts to meet the impending emergency, which came as forecast. Eight specialists were assigned to duty during the frost-danger season in the citrus and deciduous fruit districts of the Western States. There were urgent requests from fruit interests for additional service in other portions of the country. This service has become one of the most valuable conducted by the bureau. Its cooperation with fruit growers materially assists in the saving of hundreds of thousands of dollars annually.

The fruit-spray forecast service is principally for the benefit of apple orchardists. It consists of special weather forecasts as a guide in the application of sprays to combat scab and fungous diseases. The season begins in early April and continues into the latter part of June. The harvest weather forecasts are designed for the use of farmers during the harvesting season in determining when wheat, oats, and hay can be cut and harvested to the best advantage and with the least likelihood of damage from wet weather. The season runs from about the middle of June until the latter part of September. The fruit-spray service heretofore confined to the State of New York was extended in a limited way to other States, particularly Pennsylvania. The harvest-weather service was expanded to 44 counties in the State of New York. The past year was the first during which the projects were carried on as established programs, owing to the availability of the specific appropriation made by Congress for the work. In one county alone

the money value of the spray service to fruit growers was estimated from \$40,000 to \$60,000. It is estimated that about 24,000 farmers obtained the harvest-weather forecasts, and reports indicate that many thousands of dollars were saved by farmers who used the weather reports, and those who did not have reports in many cases lost heavily.

During the late summer and early fall months fruit drying is one of the principal industries of the central valley of California. Fruit to the value of \$40,000,000 to \$50,000,000 is at times exposed to the weather in trays in the process of drying. The occurrence of rain without warning a sufficient time in advance to protect by stacking the trays or placing them under shelter would cause large losses from complete damage or deterioration in quality of the fruit. Therefore, much responsibility rests on the weather forecasters and the growers depend on the Weather Bureau to advise them when protective measures are necessary. In order that the best possible service may be given to this important industry arrangements were made during the year for providing the district forecaster at San Francisco and the local forecasters at Fresno and Sacramento with special observations by telegraph from points in California and near-by States whenever conditions indicate the probability of rain in the raisin-growing districts.

The great flood period of the year was that of January, 1925, in the rivers of the South Atlantic States. The warnings of the coming, duration, and extent of the floods were issued with timeliness and accuracy. Special efforts of the Weather Bureau in assembling data and issuing flood warnings during the flood crisis were estimated to have been the means of saving \$1,000,000 to the citizens in river territories in middle and southern Alabama. Much property was saved during the year in other portions of the country through the flood warnings of the Weather Bureau, the total reported value of property saved being \$2,209,975, which, of course, is not a complete record of the saving effected.

FIGHTING INSECT PESTS

Further progress was made in fighting insect pests. The campaign for the suppression of the plum curculio in Georgia, which has resulted in the saving of several hundred thousands of dollars a year to the peach growers of the South, was this year extended to include a trial of dusting with arsenicals by means of the airplane. Further experimentation improved the paradichlorobenzene treatment for the peach borer. This treatment was developed by the department a few years ago. Its use has now been extended to the southern peach-growing districts, where it is said to save millions of dollars annually. The use of lubricating or engine oil emulsion for the San Jose scale has been extended and placed in a firm basis. It is now regarded as a cheap and efficient standard treatment for this pest. A new insecticide field has been opened by the discovery of the value of fatty acids as contact insecticides, especially efficient for plant lice and similar insects.

The Japanese beetle has been held to the region of its original infestation. The operations of the department, in cooperation with the States of Pennsylvania and New Jersey, have prevented its

spread to other parts of the country. Much progress has been made in methods of control, in the study of the biology of the beetle, and in the importation of its natural enemies. Several of these enemies imported from the Orient have become established in this country. Additional European parasites of the European corn borer have been imported.

The dusting of cotton fields with arsenate of lime by the airplane as a boll-weevil remedy, originally developed by the department, has been adopted commercially. Indications are that it will find a place in the regular routine of the large cotton planters. This means that the poisoning will be done by experts in a more satisfactory way than by farm labor. The use of the airplane in distributing arsenical dust over more or less inaccessible standing water near plantations in the delta region of Louisiana resulted in the destruction of over 99 per cent of the larvæ of malarial mosquitoes.

An improved poison bait, in which sodium fluosilicate has been substituted for Paris green, has been worked out for the control of wireworms in tobacco fields. In the case of heavy infestations the crop stand has been increased by this application as much as 12 per cent. In the work against sugar-cane insects agents of the department have developed a method of soaking the seed cane in water of ordinary temperature for 72 hours, destroying all borers of all stages and stimulating germination of the plant.

European parasites of the European earwig, an insect causing much damage in the Northwest, have been imported and liberated, with the strong prospect that at least one of them will become established at Portland, Oreg. Eradication of the sweet-potato weevil has been accomplished in what is known as the Baker-Charlton area in north Florida. This indicates that the principal threat to commercial sweet-potato growing in the Gulf States can be eliminated.

An outstanding achievement has been the discovery that the application of high vacuum can be used successfully in the control of insects attacking many products in storage. These results indicate that a high-vacuum chamber is a feasible and desirable part of the equipment of a modern storage warehouse. Work in the control of bean weevils in California has resulted in the discovery of facts concerning the biology of the weevil which will result in the saving of many hundreds of thousands of dollars to the California bean growers. The barrier zone between New England and New York State, established for the purpose of retarding the march of the gipsy moth, has been maintained successfully, and the large colony of this insect found a few years ago in New Jersey is being wiped out.

FOOT-AND-MOUTH DISEASE ERADICATION

Prominent among the department's activities in combating animal diseases was the suppression, during the last fiscal year, of foot-and-mouth disease. This highly infectious malady, which occasionally has gained entrance into the United States, was controlled and eradicated by rigorous methods of inspection, quarantine, slaughter of infected herds, and the cleaning and disinfection of premises. At the beginning of the fiscal year the extent of foot-and-mouth disease which appeared in California early in 1924 had been limited

to the counties of Los Angeles, Tuolumne, and Merced. The last outbreaks among domestic livestock in these counties occurred on August 23 and October 9, 1924, and April 5, 1925, respectively. In the testing and restocking of 702 premises which had contained foot-and-mouth disease the malady reappeared on only two, demonstrating the thoroughness with which the inspection forces conducted cleaning and disinfection.

The difficulty of eradicating foot-and-mouth disease was increased by infection among deer in the Stanislaus National Forest. Cooperation of the Bureau of Biological Survey, the Forest Service, the State Department of Agriculture, and the California Fish and Game Commission with the Federal Bureau of Animal Industry made possible the eradication of the disease from the deer in the forest. The last deer showing recent infection was killed June 10, 1925. As a precautionary measure, the Stanislaus National Forest was closed to grazing during 1925. A separate outbreak of foot-and-mouth disease in Texas was officially confirmed September 27, 1924, in a herd of Zebu cattle south of Houston. Methods similar to those used in suppressing the California outbreak resulted in the suppression of infection in Texas within 30 days. It seems probable that infection entered Texas through a gulf port, since investigation established no connection between this outbreak and the one in California.

OUTBREAK AND SUPPRESSION OF EUROPEAN FOWL PEST

In the fall of 1924 the European fowl pest appeared in the United States, menacing poultry flocks. This new, highly contagious malady broke out in the States of Pennsylvania, New York, New Jersey, Connecticut, Indiana, Michigan, West Virginia, Missouri, and Illinois. Most of the infection was limited to the four States first named. To prevent the spread of this disease the department, by official order, prohibited the interstate shipment of live chickens, turkeys, and geese affected with or directly exposed to European fowl pest. The order also required the cleaning and disinfection of premises, cars, coops, and other equipment used in handling interstate shipments of poultry affected with the disease. Affected birds were slaughtered, and, together with birds that had died, were burned or deeply buried. An appropriation of \$100,000 promptly made by Congress—in the absence of funds available for poultry-disease work in the field—contributed greatly to the thoroughness of control measures. Methods used for suppressing European fowl pest were similar to those used in combating foot-and-mouth disease. By May 1, 1925, the fowl malady was virtually eradicated; infection subsequently appeared only in one small flock of chickens in New York, where it was promptly suppressed. In dealing with such pests immediate action is half the battle. The serious effects of the fowl pest outbreak on agriculture and other industries deserve attention. Prices of poultry broke badly when the disease began to spread and producers and distributors suffered heavy losses. Poultry-dressing establishments, especially in the East, were obliged to discontinue operations, throwing thousands of employees out of work.

TUBERCULOSIS YIELDS TO AGGRESSIVE TESTING PROGRAM

It is gratifying to report that tuberculosis of livestock is yielding in the aggressive campaign waged against it by Federal, State, and county forces. Improved State laws, liberal State appropriations, and a better understanding of the work by stock owners have aided the work. Field operations for the year showed a 32 per cent increase in the number of cattle tested compared with the previous fiscal year. Tests were applied to over 7,000,000 cattle, of which 3.1 per cent showed tuberculous infection. This figure was slightly less than in the preceding year and was still lower than the average of former years. The degree of infection, however, varies widely in different States. Altogether 214,491 tuberculous cattle were detected and slaughtered, thereby removing a large menace to both the human population and farm animals.

The plan of eradicating bovine tuberculosis from areas—usually a county—is now recognized as the preferred method for conducting the work. More than two-thirds of the cattle tested during the year came under the area plan. Altogether 591 counties have completed or are engaged in eradicating bovine tuberculosis, this number representing an 86 per cent increase over last year. In addition to the county-wide activities, there was a gain of 24,110 herds accredited as free from tuberculosis, bringing the total of such herds to 72,383. The proportions which tuberculin testing has assumed in recent years may be judged from the impressive number of cattle that have received the test. More than 11,000,000 were under supervision at the end of the fiscal year, with an additional 3,500,000 on the waiting list.

In conjunction with the testing work the department has held many meetings and conferences and has distributed much educational literature and exhibit material for the information of the public. Opposition to official tuberculin testing, which some years ago obstructed the work in numerous localities, has gradually declined and is being replaced by cooperation. In fact, State appropriations for tuberculosis eradication during the year aggregated about \$7,000,000, or more than twice the funds provided by the Federal Government. The outlook for the continued eradication of tuberculosis of livestock, including cattle, swine, and poultry, is unusually promising.

FEDERAL MEAT INSPECTION

Although the inspection of food animals, meats, and their products is now commonly accepted as a "public service" Federal activity, brief comments on its current extent may be of interest. During the fiscal year the department conducted Federal meat inspection at 910 establishments in 257 cities and towns. Altogether about 75,000,000 food animals, of which more than three-fifths were swine, passed under the scrutiny of trained Federal inspectors. Federally inspected slaughter continues to represent about two-thirds of the total kill of food animals in the United States. The remaining one-third, representing mainly local and intrastate business, does not come under Federal authority.

Besides the assurance of wholesomeness which the United States meat inspection service provides, the inspection constitutes an important factor in export trade. During the year the department issued more than 100,000 official meat-inspection certificates. These covered the exportation of over 1,500,000,000 pounds of meat products and over 100,000,000 additional pounds of inedible animal products. During the year imports of meat from abroad were a very small percentage of the export business. Records of meat inspection afford livestock producers much information concerning the health of farm animals received at the principal market centers. Of 35 diseased conditions that occur with greatest frequency among animals offered for inspection, tuberculosis is by far the most serious. This disease caused more condemnations of cattle carcasses than all other diseases and ailments combined. It also was by far the most important cause for condemnation of hog carcasses and parts.

TICK ERADICATION MAKES PROGRESS

Previous success in eradicating cattle-fever ticks from Southern States has resulted in a continued vigorous campaign to free the entire South from this pest, which causes disease and a large economic loss. Of 975 counties quarantined because of cattle-fever ticks on July 1, 1906, when the work of eradication was launched, 529 were released from quarantine and were tick free November 1, 1924. The complete eradication of cattle ticks from 71 counties is one of the outstanding achievements of the current tick-eradication season. On December 15, 1924, Federal quarantine restrictions were lifted from the entire State of Georgia following the success of tick eradication in that Commonwealth. Progress in destroying the pest required the use of over 25,000 dipping vats and more than 24,000,000 inspections or dippings of cattle were conducted.

The department continues to stress the importance of completing tick eradication in areas released from Federal quarantine, but in which a small degree of infestation remains, such premises being continued under quarantine regulations. The importance of "clearing up" such areas of potential danger with vigor is shown by abundant field experience. Many of the encouraging results here reported are due to the use of two portable motion-picture outfits that have molded a favorable sentiment for this work. The motion pictures show proper methods of conducting tick eradication and the benefits to be derived. These machine exhibits are given in small towns and in rural schoolhouses in tick-infested districts, 530 showings having been made during the year.

LIVESTOCK IMPROVEMENT

Information received from many sources shows the continued improvement of livestock in the United States with respect to its breeding and utility value. Although much of this progress is of an intangible nature, department records obtained under the "Better Sires—Better Stock" plan show an unmistakable trend toward the wider use of purebred sires and subsequent improvement in the quality of herds and flocks. Under the plan mentioned livestock owners signify their intention to use purebred sires exclusively for all classes of livestock kept and report the number and quality of

their breeding stock. During the year approximately 1,500 stock owners definitely placed their livestock-breeding operations on a purebred-sire basis, bringing the total number participating since the work started to 15,818. Moreover, six more counties qualified for the list of those having 100 or more livestock owners using purebred sires of good quality in all breeding operations. At the end of the year 41 counties had reached this goal.

Records continue to show that ownership of purebred males leads promptly to a large number of purebred female animals in all classes of stock kept and to a gradual grading-up process, with the reduction of scrub stock to a negligible number. Information obtained during the year by an extensive questionnaire covering 45 States shows that the high utility value of purebred livestock is becoming recognized by stockmen. The inquiry showed that more than half of purebred food animals are marketed directly for meat purposes; that purebreds are much more profitable to raise than scrubs, and somewhat more so than grades, the degree depending on the proportion of pure blood the grades possess; and that about 96 per cent of persons who give purebred sires a fair trial stick to the general principle of using them for all classes of stock. According to farmers' reports, purebred meat animals cost slightly less than scrubs to raise to maturity; purebred dairy cattle cost slightly more. Purebreds are, of course, worth much more when raised. The same inquiry indicated that only about half of the purebred animals eligible to registration are actually registered. This matter is of interest in connection with figures of the last census showing the number of registered purebred livestock. The principal reasons for not registering purebred animals, as reported, are intention to sell for slaughter, poor individuality, and lack of demand for registration papers when stock is sold.

LOW HOG-CHOLERA LOSSES

The swine industry during the last fiscal year experienced the smallest losses from hog cholera since official records of the disease have been kept.

At times cholera has taken toll of as high as 10 per cent of the swine, whereas last year the loss from this cause was only 3 per cent. The lessened prevalence of the disease has caused swine owners to give less attention to immunizing their animals, with the result that more swine herds on farms are left susceptible to hog cholera than in other years. Consequently, heavy losses may be expected should the disease begin to spread before outbreaks can be checked. Promptness in immunizing swine, should outbreaks appear in a locality, is therefore extremely important if such outbreaks are to be checked promptly.

A system of swine sanitation, developed in McLean County, Ill., several years ago by department workers, has spread widely throughout hog-raising States. The system controls roundworms and related filth-borne diseases of young pigs. Pigs raised in accordance with the system grow and develop more evenly and are ready for market fully a month earlier than under usual methods of management. The experience of numerous swine raisers in the Corn Belt, who have practiced the method, shows that they can rear as many

pigs as formerly with two-thirds as many brood sows. Death losses and runts caused by worms and hog-let diseases are avoided almost entirely. Extension workers in Iowa, Nebraska, and other States, as well as in Illinois, are actively engaged in extending the system which has resulted in so many benefits.

LIVESTOCK RESEARCH

Research on livestock problems has gone forward steadily. Several investigations have led to results of outstanding promise. A method of producing immunity against tuberculosis is being tested, with results thus far of an encouraging nature. Another promising series of experiments deals with the mode of action of disinfectants. Results furnish new information on the germicidal power of disinfectants with relation to their chemical composition. Other research deals with the study of bovine infectious abortion, factors influencing soft pork, the vitamin content of meat and meat products, the chemistry of plants poisonous to livestock, tests of chemicals to remove internal parasites, and rabies. There is a popular idea that rabies is a disease of the hot "dog days" of summer, but a large proportion of the suspected animals examined by department scientists were brought to the laboratory during the months of December, January, February, and March.

THE SYNTHETIC-AMMONIA PROCESS

The most striking recognition of the work of the Fixed Nitrogen Research Laboratory during the last year has been the adoption of its synthetic-ammonia process by an American company. The company, with the cooperation of the laboratory, has applied the process in a plant that was put into successful operation in the spring of 1925. This is an outstanding result of research work extending over several years. The plant operates at a pressure of 300 atmospheres (4,400 pounds per square inch) and is capable of producing 3 tons of ammonia per day. Its successful operation within so short a time after its construction demonstrates the soundness of its design. The synthetic-ammonia process is in a continual state of development. The present process, with its various improvements, may be regarded as a considerable step in advance of the Haber process as originally installed in Germany. Still another process, the French or Claude process, is now being installed in this country. It will operate at 900 atmospheres (about 13,000 pounds) pressure.

In the prosecution of the nitrogen-fixation work, which necessarily involves the employment of unusually high gas pressures, a satisfactory engineering practice had not been developed in some of the details of high-pressure equipment. This was especially true of high-pressure relief valves and gaskets. Such "pop valves" as existed were more in the nature of emergency or safety equipment, which were rendered useless or required extensive refitting after each accidental operation. An automatic continually operating high-pressure relief valve has been designed and successfully used. It has application not only in the nitrogen-fixation indus-

try but in all others employing high pressures of gases, vapor, or steam. It has been most favorably received by the various industries which can use it, especially by manufacturers of compressor equipment.

The increasingly high pressures utilized in ammonia synthesis have developed another pressing need in high-pressure engineering, namely, suitable gaskets to withstand all pressures. The old principle of gasket design for high pressures was to make them broader the higher the pressure to be resisted, on the theory that the greater the area of contact the greater would be the resistance. The falsity of this principle was recognized in this laboratory when it was realized that by distributing the pressure that could be applied to the gaskets over too great a gasket area the pressure per unit area would thus be reduced below the pressure of gas to be withstood, and consequently blowouts would inevitably result. A method of designing the gasket area and reducing it exactly to fit the conditions of use has brought about the greatest improvement. This design is also being eagerly adopted by the ammonia industry.

Although it has been recognized for a long time that some nitrogen from the atmosphere becomes fixed in the form of cyanide in blast-furnace gases, no serious effort has been made in this country to determine whether the quantity is commercially important and whether it would be feasible to recover it. No actual attempts at recovery have ever been made. In cooperation with the Bureau of Mines a complete survey has been made of one blast furnace in the Birmingham district. The results of the survey show that cyanide is produced in the gases in a concentration which should render its recovery economically profitable. This survey will be extended to other blast furnaces with the ultimate object of recovering this source of cyanide which would otherwise be wasted and which is essential in producing hydrocyanic acid for application as an insecticide in the citrus-fruit industry.

In the realization of the difficulties that will be encountered in the direct introduction of concentrated forms of nitrogen into the fertilizer industry this laboratory has been cooperating with other bureaus in the department. The object of this cooperation is, on the one hand, to prepare the way for stimulating the use of concentrated fertilizers from the agricultural standpoint, and on the other, to give the farmer the advantage of such use through obtaining proper freight rates on the concentrated products. This will mean a reduction in the cost of shipping the smaller tonnage of the concentrated material. Active cooperation with the Bureaus of Soils, Plant Industry, and Agricultural Economics has been sought and obtained in the prosecution of these objects.

FINDING "BAIT" FOR BOLL WEEVILS

Chemists in the department completed an investigation to ascertain the odorous constituents of the cotton plant. This investigation was undertaken to ascertain the chemical nature of the substances which are presumed to attract the boll weevil. Since the cotton plant possesses a specific attraction for the boll weevil, it has been supposed that this was owing to the emanation of some odorous sub-

stances which could be detected by the insects at a considerable distance. It was thought that if an odorous substance could be identified which by actual tests would be found attractive to the insects, it might be possible to produce it in sufficient quantity to permit of its use as bait. In the course of the investigation a large number of definite chemical compounds, some of which have a very pleasant odor, were isolated from a distillate of the plant. These volatile basic substances are constant exhalations of the plant and it has been found by field experiments which are being continued that one of them (trimethylamine) possesses some attraction for the boll weevil.

Several other important chemical discoveries deserve note. Lignin is a cellular substance which is widely distributed throughout the plant kingdom. A number of agricultural products which are not now fully utilized contain it in large quantities, as, for instance, corn-cobs, cornstalks, straw, cotton-plant stalks, and the like. Heretofore no method has been known for extracting lignin from the material in which it is found. The department's Bureau of Chemistry has discovered a solvent which dissolves the lignin. An investigation of the lignin in corn-cobs resulted in the discovery that when it is dissolved in this solvent it forms an excellent varnish. This varnish is water and acid proof, and when applied to wood it gives a shining and transparent surface. Other profitable uses for it may be found.

Owing to the highly inflammable and explosive properties of carbon disulphide, the objections to its use as a fumigant for destroying insects in stored grain are so serious that fire insurance companies refuse to carry the risk on elevators, bins, and other property while it is being employed for this purpose. The railroads have prohibited the use of carbon disulphide except at two designated isolated points for fumigating cars loaded with grain. Because of this situation the Bureau of Chemistry in cooperation with the Bureau of Entomology undertook an investigation to discover a safe, effective fumigant to take the place of carbon disulphide and as a result has developed a new fumigant consisting of a mixture of ethyl acetate and carbontetrachloride, which is effective in killing destructive weevils in wheat in box cars, grain elevators, and other tight inclosures. This fumigant is noninflammable at fumigation temperatures, is noninjurious to those handling it, does not lower the germinating quality of seeds, and does not injure the baking quality of flour from fumigated wheat. It costs less than 1 cent per bushel for fumigated wheat. Great benefit will result to those producing and handling wheat from this development of a fumigant which can be used without voiding the fire insurance on the buildings. The results of this investigation in detail are published in Department Bulletin No. 1313.

The unusually small cane crop last year caused an increase in the price of cane sirup, particularly unsulphured sirup. This situation made it profitable for sugar-cane growers in certain sections to convert part of their cane into sirup instead of sugar. However, the method of making cane sirup which has customarily been used in the sugar district of Louisiana is that in which sulphur fumes and lime are used for clarifying the juice. This process imparts a peculiar sulphured flavor to the sirup, which interferes with extension of the market. Investigations conducted at two Louisiana plantations resulted in an improved method for producing unsulphured

sirup under the conditions prevailing there. This was an achievement of considerable economic importance, since under existing market conditions the margin in favor of making cane sirup instead of sugar amounted to as much as \$2 per ton of cane. The foregoing illustrates the application of chemical research and chemical technology to a practical problem, with the object of procuring such flexibility in the manner of utilizing a crop as will permit better adaptation to changing conditions and markets.

Previous investigations had resulted in the development of a method for preventing crystallization of cane sirup by use of the enzyme invertase derived from yeast. During the past year this method was extended to sorghum sirup, and its use has permitted the production of sorghum sirup which does not crystallize even when concentrated to the high density which is frequently desired. Crystallization causes the sirup to have an unsightly appearance, which is detrimental to profitable marketing of the sirup, especially when it is concentrated to the high density so often desired by consumers.

As the result of the application of methods developed in the plant-dust-explosions work carried on in the Bureau of Chemistry there were no dust explosions of major importance involving large loss of life and property during the last fiscal year in the grain-handling industries. This is in marked contrast to the previous year, when a number of explosions occurred, the principal one being the starch-dust explosion at Pekin, Ill., in which 42 men lost their lives and approximately \$500,000 worth of property was destroyed. Much of this prevention has been due to the work of the bureau in bringing to the attention of the industries the hazards of dust explosions and methods that can be adopted for their control. This applies principally to the grain-handling industries, in which field the bureau has been principally engaged. In addition to the industrial phase of the work the progress made in the adoption of methods for the prevention of explosions and fires in threshing machines in the Pacific Northwest and fires in cotton gins in the Southwestern States has been very gratifying. The insurance underwriters in the Northwest are offering considerable reduction in insurance rates for the installation of dust-collecting fans in accordance with the specifications worked out by the engineers of the Bureau of Chemistry. This reduction in rate will mean considerable saving in insurance premiums to the farmers and threshermen in that section and has also brought about the general adoption of precautionary measures for the prevention of these explosions and fires.

A chemical method for determining maturity in cantaloupes has been worked out, published, and successfully applied in the industry in California during the past year. The test is now being applied commercially in California to determine when to pick cantaloupes for the market. The value to the growers and consumers of a proper test for maturity of cantaloupes lies in the difficulty of placing California melons in eastern markets in a satisfactory condition unless they are picked at the right stage of maturity. If allowed to become too nearly ripe before being picked, they can not be kept in good condition until they reach consumers. If, on

the other hand, they are picked too soon, the flesh becomes shriveled and tough, lacking in color and odor and disappointing in flavor. One of the horticultural commissioners in a cantaloupe-producing section of California recently stated that "the establishment of the soluble-solids test for determining the maturity of cantaloupes has practically revolutionized the cantaloupe industry and has been of inestimable value to the growers. Before this method was established the different interstate markets were demoralized by the continuous shipment of green cantaloupes, but this system has eliminated all question as to the maturity of our produce and has proved very economical and practical."

Several promising repellents for use against the screw worm and other flies attacking animals have been developed as a result of the work carried on in southwestern Texas by the Bureau of Chemistry in cooperation with the Bureau of Entomology. It is conservatively estimated that during a year 1 per cent of all cattle, sheep, and goats in that section are infested with screw-worm larvæ, thus jeopardizing annually the lives of animals valued at over a million dollars. Present repellents for screw-worm flies are either largely ineffective or highly toxic to their hosts. This investigation has shown that certain chemicals in various combinations with certain pine-tar oils give very satisfactory results in repelling screw-worm flies from wounds on animals. These preparations also aid in promoting a more rapid healing of the wound.

In an investigation to develop methods for the standardization of raisins, a test depending upon the catalase activity of mold was developed for determining the extent of mold injury in raisins. It was found that if raisins are placed in hydrogen peroxide moldy fruits will at once begin decomposing the reagent with an immediate evolution of oxygen. This makes it possible readily to detect and count the moldy raisins in a given lot. This test can be applied in the field and may be used to settle disputes between buyer and seller as to the extent of damage from mold to any given lot of raisins.

A study of the mold group *Aspergillus*, begun about 20 years ago and systematically followed throughout the period, has been completed. Molds of this genus are exceedingly abundant in food, in feeding stuffs, in stored grain, hay, fodder, and even occur as human and animal parasites. In spite of their importance and abundance, however, no critical study of the whole group has been reported in English and no such study has been published in any language for more than 20 years. Studies of sections of the group are to be found in publications from this bureau and in French and German.

TRUTHFUL LABELING OF FOODS AND DRUGS

Through the enforcement of the Federal food and drugs act, commonly called the pure-food law, progress was made in promoting the purity and truthful labeling of foods and drugs that are imported into this country or shipped into interstate or foreign commerce. Action was taken to prevent adulteration and misbranding of a large number of products, but there were some outstanding features of the work on certain products. The enforcement work designed to prevent the canning and distribution of decomposed or partially decomposed salmon reached its culmination during the

year. Following inspection of canneries which revealed that rotten fish were being packed by certain canners libel actions were directed against a number of very large shipments. These seizures, as well as others pending from the previous year, were practically all terminated during the year. The Government was uniformly successful in establishing its contentions where contests in the courts occurred. These actions have resulted in packs which, with few exceptions, promise this season to show little ground for criticism.

How the enforcement of the food and drugs act renders constructive assistance to the industry as well as giving protection to consumers is illustrated by the action on California frozen oranges during the past year. In December, 1924, the California orange groves were visited by a disastrous freeze, which damaged a very large percentage of the fruit then coming into maturity. In much of the fruit the frost damage is not visible in any marked external way, but the fruit in a short time becomes dry and pithy, a condition which is often not discovered by the uninformed purchaser until after the fruit is cut. Knowing that the shipment and sale of such damaged material would result in a fraud to the ultimate purchaser and would also seriously damage the prestige of the California fruit, the vast majority of the growers desired to prevent the shipment of such damaged fruit. In every industry, unfortunately, there are certain individuals who will take advantage of opportunities to ship such material, regardless of the future damage which may be done to the reputation of the industry as a whole and of the cheat upon the consumer.

The authority of the Federal food and drugs act was enlisted to prevent the shipment into interstate commerce of frost-damaged fruit, and through the cooperative action of the State and county authorities of California and the Federal agents of the Bureau of Chemistry a patrol was maintained continuously during the period following the freeze, as a result of which shipments of frost-damaged fruit were practically prevented. The effect has been the saving of thousands of dollars to the eastern consumer, who would otherwise have paid the price of sound fruit for a frost-damaged article, the maintenance of the high standard of the California fruit, and the assurance that the California grower who shipped only sound fruit would receive a full and adequate return for his product.

DISCOVERIES IN CHEMISTRY

American manufacturers are now producing vat dyes of brilliant color and lasting quality as the result of processes developed by American chemists for making cheaply and of remarkable purity two dye intermediates which formerly could be obtained only in Germany. The process for making one of those essential intermediates, phthalic anhydride, was worked out in the Bureau of Chemistry and has been outlined in previous reports of the chemist. Because they are fast and durable, vat dyes are especially adapted for cotton goods and their use is being rapidly increased. In 1914 no vat dyes were manufactured in the United States and 1,945,304 pounds were imported. In 1924 there were manufactured in this country 1,821,319 pounds of vat dyes and 1,499,322 pounds were imported exclusive of the vat dye indigo.

All the phthalic anhydride now manufactured in the United States is made by the process worked out in the Bureau of Chemistry. This essential intermediate has been sold in Europe because of its comparatively low cost and its exceptionally high purity. Approximately 2,300,000 pounds were produced in this country in 1923.

The average price of phthalic anhydride manufactured in America has been about 29 cents per pound, although quoted as low as 16 cents. Before the war the price of the product made in Germany was approximately 30 cents, which would be to-day equivalent to 53 cents. The American product is not only relatively lower in cost but is also higher in purity.

PLANT QUARANTINE ACT

The plant quarantine act of 1912 is undoubtedly one of the most useful laws ever enacted by Congress in the interest of American agriculture and forestry. In view of certain misunderstandings with respect to some of the many features of control being exercised under this act, it seems desirable to present a brief statement of its purpose and the broad protective powers under it which are being exercised.

The main purpose of the act is to prevent, so far as possible, further inroads of foreign insect pests and diseases of plants by controlling or prohibiting the entry of any plant or plant product which may be the vehicle for the introduction of such pests. Aside from certain minor efforts by one or two States, no control over such entry of foreign pests had been exercised prior to 1912, with the result that a veritable stream of new pests was entering this country and becoming established. The large development in world commerce in plants, fruits, and vegetables during the last 30 years has greatly increased the danger of such introductions of pests. The increasing entry of such products from Asia, Africa, and other remote regions led to the entry of many pests absolutely unknown, and hence impossible to guard against, such as the chestnut blight, citrus canker, Japanese beetle, and oriental fruit worm.

As illustrating the rate of entry of such enemies, no less than six new major pests gained entry and establishment during the four years immediately preceding 1912. These are the oriental fruit worm, Japanese beetle, citrus canker, potato wart, European corn borer, and camphor scale. These and plant enemies earlier introduced now represent the more important pests of agriculture and forestry in this country and involve annual losses to farm crops which have been conservatively estimated at upwards of \$1,000,000,000. Most of these pests are now thoroughly established and widespread in the United States. Some of the more recently introduced ones, however, have still such limited distribution or local foothold as to make it desirable, under any reasonable expenditure, to hold them in check and prevent their spread as long as practicable. The importance of such new pests is indicated in some measure by the fact that Congress is now making annual appropriations for their control, prevention of spread, and in some instances

eradication, of sums totaling upwards of \$2,500,000. Such control within the United States of new plant enemies or diseases is the second important object provided for in the act.

For the prevention of entry of known foreign pests about 22 quarantine and restrictive orders prohibiting or regulating entry of plants and plant products are now being enforced. The domestic quarantines enforced under this act deal with such newly established pests as the pink bollworm of cotton, the Japanese beetle, the European corn borer, the white pine blister rust, and the black stem rust of wheat. In addition, all border traffic with Mexico is, under special authority from Congress, regulated and safeguarded. This involves the inspection and disinfection of railway cars, freight, express, baggage, and other materials entering from that country, with the purpose, more particularly, of protecting the great cotton industry of the South from further invasion by the pink bollworm and also of excluding various fruit and other crop pests.

That the restrictions on plant entry from foreign countries have been fully justified by the results is indicated by the fact that during the 13 years of enforcement of this act, there has been, with one exception—the entry of the pink bollworm of cotton from Mexico—so far as known, no establishment of an important new pest. This is in striking contrast with the record of the few years immediately preceding 1912.

There has been much misrepresentation and misunderstanding relative to the exercise of the admittedly large quarantine and control powers under the act, and the statement, which has been widely circulated, that the exercise of such powers is entirely controlled by a small independent group within the department, has no basis. To prevent any such individual or arbitrary action, the act provides for an administrative board to be appointed by the Secretary of Agriculture from the personnel of the three important bureaus of the department dealing directly with the farm and forest resources of the Nation. This provision unites the Bureaus of Entomology, Plant Industry, and Forestry as the administrators of the act, advisory to the Secretary. To further safeguard the exercise of these powers, the act is mandatory in requiring that, prior to the issuance of any quarantine or restrictive order, a public hearing shall be held at which any person interested shall have opportunity to be heard.

The need for taking measures—drastic if necessary—to protect American agriculture from the devastation of additional foreign pests and diseases is universally admitted. It follows that some competent body must make the determinations with respect to the necessary restrictions and safeguards. Congress has placed that responsibility on the United States Department of Agriculture. Certainly this department, with its hundreds of specialists in the fields of plant production, insect enemies, and diseases of plants, would seem to be the proper agency for making such decisions.

Before adopting the present general policy of restricting the entry of foreign plants to horticultural, educational, and scientific needs, the department gave seven years' trial to the system of unlimited entry under foreign inspection and certification, with such reexamination of the imported material as was possible at destina-

tion in the United States. That this system was fairly tried out there is no question, and its failure was clearly indicated by the startling record of pest interceptions with such imported material, and still more by the realization that such interceptions, under the conditions of reinspection possible in this country, necessarily represented only a small part of what was actually coming in.

Under the policy of restricted entry no plant or class of plants is embargoed, but any plant may be brought in for any of the essential purposes indicated above, under the safer inspection and control methods which are possible with limited imports. The importations of restricted or so-called "embargoed" plants, during the six-year period, 1919 to 1925, totaled nearly 50,000,000 plants and, as indicating the liberality of entry under these provisions, it may be noted, for example, that there have been thus imported 80,000 rose plants, representing over 2,000 different varieties, 1,000 different varieties of gladioli, and about 1,700 different dahlias.

WORK UNDER PURNELL ACT

An event of national importance was the passage by Congress of the Purnell bill, making provision for increased appropriations for the agricultural experiment stations in the States. This act, which was approved February 24, 1925, not only enlarges the funds for research relating to production but makes specific provision for investigation in the fields of agricultural economics, home economics, and rural sociology. These lines have received only limited attention at the stations in the past, and are felt to be of national importance in developing the agricultural industry, the rural home, and rural life.

This legislation is a further recognition of the value of research and the large dependence which must be placed upon it in advancing the agricultural industry and country life. It is also a renewed expression of approval of the State experiment stations, which are working close to the local problems and many of whose findings are regional or national in their application. It is planned to join up more closely than ever before the investigations of the State stations and those carried on by the Federal Department of Agriculture.

Plans are already under way which will greatly increase this cooperation and provide for coordinated attack on a great variety of problems in the fields of production, distribution, and rural life.

It is confidently expected that this increasing support of the State experiment stations and the closer coordination of their work with that of the department will mark a notable increase in efficiency in studying the problems of agriculture and providing sound information as the basis of improvement. In order to determine policies to be followed in carrying out the provisions of the Purnell Act a widely attended conference of presidents of the agricultural colleges, directors of the State experiment stations, and representatives of this department was held in St. Louis in April, 1925, at which several problems of national scope were adopted as subjects for cooperation between the States and the department. Special committees composed of leading specialists were appointed to outline these problems and serve as a means of inaugurating cooperative investigations under them. Regional questions for cooperative

study were also outlined by representatives from the several sections of the country. The plans for these cooperative investigations on a national scale have since been matured and the work started. With proper encouragement and direction the movement should not only avoid unnecessary repetition or duplication but unite the research agencies in their studies of questions of broad scope and importance.

SOIL SURVEYS

The main work of the department's Bureau of Soils, that of identifying and mapping the soils of the United States, is continuous. Its results vary from year to year mainly in the area covered, which is dependent upon the funds available. The area covered during the fiscal year ended June 30, 1925, was 27,837 square miles, an area large enough to make 120,214 farms of the average size in the United States. The total area surveyed in detail to date is 684,451 square miles, and is about equal to the combined areas of Norway, Sweden, France, and Germany. No other country in the world has amassed any such store of knowledge concerning its soil resources; probably not all the other countries combined have anywhere near approximated the United States in this field. The area surveyed in 1925 was a little greater than that covered in 1924 and not far from the average covered in the last five years.

At the request of the Tropical Plant Research Foundation, the Bureau of Soils cooperated during the year in a general study of the soils of Cuba. Nearly 50 distinct soil types were recognized and defined. Many of these cover wide areas. Heretofore the soils of Cuba have been known as red, mulatto, black, savana, and coco soils, a classification entirely inadequate. The bureau's survey has shown at least four distinct classes of red soils, ranging from those peculiarly adapted to Cuba's chief crop, sugar cane, to others on which this crop can not be grown at all. As a result of the survey, fertilizer experiments have already been started on certain soils indicated as being suitable for sugar production.

Highway engineers in the Government service testify to the value of soil maps in road building. By using the soil maps considerable uncertainty as to the action of certain clay soils as road foundations can be immediately eliminated, expense avoided, and a better road built. Of the various soil classes the clays, it has been found, are likely to give most difficulty, and of the soils of the general class those having certain properties, such as high plasticity and low friability, are the most troublesome.

A few years ago the Bureau of Soils showed that soils contain an appreciable quantity of particles so small that they are visible only in the ultra-microscope. Some heavy clays contain 80 per cent or more of these particles which are known as colloids. Further study shows that the colloidal material is almost exclusively responsible for many of the most important properties of the soil, such as coherence, plasticity, and adsorption of salts and vapors. However, the colloidal materials of different soils may vary widely in their properties. Thus it is necessary to know the kind as well as the quantity of colloidal material in the soil before the properties and behavior of the soil can be predicted. During the past year it

has been found that the various properties of the colloid are more or less interrelated and that the properties are dependent upon the chemical composition of the material. This discovery points the way to modifying the old systems of mechanical and chemical analyses of the soil so that they will give more information concerning what a given soil will do and what it needs. Applications of the new information are already being made in the general fields of soil fertility, soil engineering, and soil classification.

Incidental to the investigation of the fertilizer value of the several cocoa by-products, research by the Bureau of Soils brought out the fact that solvent-extracted (defatted) cocoa, a waste product, is suitable raw material for the preparation of the alkaloidal drug, theobromine. As a direct result of this discovery, a large drug manufacturing concern already has started construction of an alkaloidal extraction plant with sufficient capacity for handling the entire output of the defatted cocoa by-product. The investigation indicates furthermore that the ultimate defatted, dealkaloidized product may prove to be a better "crude ammoniate" than the present by-product.

From the point of view of the future development of a large and permanent potash industry the greensand beds of New Jersey, Delaware, Maryland, and Virginia are America's most promising deposits of potash-bearing minerals. In the greensand deposits of New Jersey alone it is estimated by the Geological Survey that the mineral here available by open-pit mining methods alone would supply 257,000,000 tons of potash, which at present rates of importation from the European market would supply the United States for nearly 1,000 years. If consideration were given the additional quantities obtainable by underground mining and available in other States, these figures would be enormously increased.

Processes for the extraction of potash from greensand developed in the Bureau of Soils make possible its recovery on a commercial basis, together with a list of side products including iron oxide, ochers, alum, alumina (the raw material for the manufacture of metallic aluminum), and "glaucozil," a form of silica of many unique and valuable properties. This process is now under active exploitation by a company at Odessa, Del., and is being investigated by chemists and engineers generally with a view to large-scale production of potash from greensand. Research work is still in progress on this problem designed to improve certain steps in the process and the purity of the products obtained.

Investigations in the laboratories at Arlington Experiment Farm on the home-mixing of fertilizers have shown that, using the materials employed commonly by the trade, it is not only feasible but under many conditions advantageous to the farmer to mix his own fertilizers. Of special interest is the work showing that home-mixed goods are as uniformly mixed as factory-mixed goods. This is a question long in dispute.

The most concentrated materials suited for use in fertilizers are ammonium phosphate, potassium phosphate, and potassium nitrate. These three materials represent all the possible combinations of the three essential constituents of fertilizers. Complete fertilizers may be made by combinations of any two or all three of

these materials, and certain of these mixtures are the most concentrated that it is possible to make.

Processes for the manufacture of these materials have recently been developed in investigations being conducted in the Bureau of Soils laboratory at Arlington Experiment Farm. A process which gives the two first-mentioned materials simultaneously has been tested on a semicommercial scale and shown to be entirely practicable. A new process also has been developed for the preparation of potassium nitrate, the third of the concentrated materials mentioned. This process gives a product, which, unlike those now recovered in the arc process of nitrogen fixation, is not strongly hygroscopic. The process has not yet been tested on a commercial scale, but the simplicity of the procedure and the relative superiority of the recovered product over those now obtained in the synthetic preparation of nitrates make the process a promising one for commercial application.

PREDATORY-ANIMAL CONTROL

Good progress has been made in the cooperative campaign of the department in the Western States for the reduction of losses, mainly on the public domain, from such destructive predatory animals as timber wolves, coyotes, and mountain lions. Since this campaign began in 1915 more than 5,830 wolves, hundreds of thousands of coyotes, and more than 1,460 mountain lions have been destroyed. In some States where timber wolves existed by hundreds and were excessively destructive their numbers have been brought down to less than a dozen. During this year the cooperating States contributed \$394,374, with the active participation in the field of great numbers of stockmen. The department expended \$270,967.

Several outbreaks of rabies among predatory animals on the ranges in different States were suppressed by prompt and intensive campaigns against them, and similar action prevented the possible spread of foot-and-mouth disease by these carriers. The success of the cooperation of the Biological Survey with the Bureau of Animal Industry and the State of California in suppressing a serious outbreak of foot-and-mouth disease among deer has saved that State, and possibly the country, from a grave danger.

Losses in cultivated crops, orchards, vineyards, and forage from a variety of injurious rodents, as prairie dogs, ground squirrels of many species, jack rabbits, and pocket gophers, aggregate many millions of dollars each year. In addition, these pests undermine roads, irrigation-ditch banks, and railway embankments. So heavy are the losses from this source that the department receives vigorous cooperation from the 18 States in which organized campaigns against rodents are being conducted.

During the year the States provided \$447,041 and the active field assistance of many thousands of farmers and other landowners, as against the expenditure of \$158,675 by the department. The eradication of most of the prairie dogs and ground squirrels was accomplished on more than 11,500,000 acres, and in addition the second treatment by poison or fumigation for the destruction of these pests covered more than 7,700,000 acres.

Under the authority conferred by the new Alaska game law, passed at the last session of Congress, the Secretary of Agriculture

appointed a game commisison which will cooperate with the department in enforcing its provisions for the conservation of the valuable resources of game and fur in the Territory. During the year more than \$2,000,000 worth of furs was procured in Alaska, and probably half that value of game. These resources under proper guardianship can unquestionably be increased.

The members of the new game commission, one from each of the four judicial divisions of the Territory, and the fifth, the chief representative of the Biological Survey in Alaska, met in April and May and recommended for promulgation by the Secretary an admirable set of regulations governing the conservation of wild bird and mammal life. The keen interest of the members of the Alaska Game Commission in the future of the wild life of the Territory and the good will shown by Alaskans in accepting the new law, indicate an excellent opportunity for building up and perpetuating one of Alaska's most valuable natural resources.

FEDERAL PROTECTION OF MIGRATORY BIRDS

Migratory birds, both as destroyers of injurious insects and as game, are actually worth many millions of dollars annually to the country. In enforcing the terms of the migratory-bird treaty act the department has succeeded in vastly increasing the number of game birds and many of the insectivorous species.

A very definite and growing menace to the future of our supply of migratory wild fowl lies in the rapid and indiscriminate drainage of water areas throughout the country. Such drainage operations are generally with the avowed object of increasing available agricultural lands. In many instances, however, the result has been the destruction of valuable water areas, leaving worthless lands exposed, a great acreage of which continues to lie in an unproductive condition. The adverse conditions affecting wild life through the increase of population call for an increasing effort to conserve our wild-life resources.

THE BANDING OF MIGRATORY BIRDS

Under supervision of the department numbered aluminum bands are placed on the legs of migratory wild fowl in order to learn the movements of these individuals from one part of the continent to another for the purpose of ascertaining their routes of migration and to gain other information necessary in the administration of the migratory-bird treaty act. A striking illustration of the practical value of banding operations is afforded by the results obtained during the summer of 1924 on the breeding grounds of wild geese near the delta of the Yukon in Alaska. During the succeeding autumn a considerable number of these banded birds were killed in the extensive area from the Queen Charlotte Islands on the coast of British Columbia to Washington, Oregon, and California, where in restricted areas these geese and certain ducks banded on the breeding grounds with them evidently have their winter homes. The operations furnish an example of how bird banding affords data on which protective measures for a species can be scientifically based.

VIII. THE DEPARTMENT OF AGRICULTURE: THE NATIONAL FORESTS

GRAZING LEASES

During the last year the viewpoint has been expressed by representatives of the range-livestock industry that the status of grazing as a permanent and desirable use of the national forests should be defined by legislation and not left, as at present, to the exclusive control of the Department of Agriculture through administrative regulations. Thirty-one thousand livestock owners range approximately 1,800,000 cattle and 6,500,000 sheep in the national forests for varying portions of the year. These represent about 20 per cent of the cattle and 28 per cent of the sheep in the 11 Western States, and with their dependent ranch investments constitute an important part of the economic structure which the national forests should sustain. No provision for grazing in the national forests has been made by Congress and the use of their ranges has been developed entirely under regulations of the Secretary of Agriculture. Although having the force of law, these may be modified or revoked in the discretion of the department. Hence many stockmen desire legislation that will fix the status of grazing with reasonable definiteness, as the production and utilization of timber are now safeguarded and authorized by acts of Congress.

The desires of other grazing permittees in the national forests go much further. They ask for some form of permanent or vested property right acquired by past use of the range in connection with local ranches dependent upon pasturage in the national forests for their economic utility. This viewpoint is the outgrowth of a sense of proprietorship in the national-forest ranges by virtue of pioneer settlement. It seeks to place public ranges in the same legal relationship to the property of the livestock producer as a water right acquired under the usual terms of State law or an easement secured through a long tenure of use. Carried to its logical conclusion, this conception of vested rights would exclude from national-forest range any new user, settler, or livestock producer of the future, except as the grazing preferences of present users might lapse or be acquired through purchase. It would in effect close the national forests to the use of range in connection with the development of new agricultural land or the normal expansion of small livestock enterprises, except as old users might choose to sell their rights to the newcomer.

The stockmen recognize that grazing in the national forests should not be permitted to injure other resources, such as the regrowth of forests, water sources, or the perpetuation of valuable wild life. They also recognize the need for preserving the forage itself from injury through overgrazing or unwise methods of grazing. But in seeking to base the use of the range upon a legal right, they desire to set aside direct administrative control by officers of the department, for protecting the range and other resources, and to substitute for it a judicial determination of the responsibilities of the range user with resort to the Federal courts in all cases of dispute. The most extreme viewpoint of the relationship desired by stockmen toward

the general conservation program of the national forests is that the range user should be responsible to the courts only for such *willful* damage as may be charged against him.

The sense of a moral right acquired through long usage in connection with dependent ranches underlies the attitude of many range men regarding the fees which should be charged for grazing in the national forests. It is argued that long use of the range in connection with the early settlement of agricultural lands has resulted in capitalizing the value of the public pasturage as part of the value of the ranch; and hence for the Government to charge the present commercial value of the forage is in effect to confiscate property values previously acquired by the pioneer. Many stockmen thus maintain that the Government should charge no more for grazing than the cost of administering this use of the national forests and of improving them for the benefit of livestock production. To charge more than a nominal rate based on these principles is vigorously combated as a policy of commercializing public resources not consistent with the equities acquired by the old range users. At the Salt Lake meeting of representative sheep and cattle growers, held in August, 1925, a resolution was adopted to the effect that no charge for grazing on national forests should be made which will depreciate the value of the ranches owned and used by the permittees. Many other stockmen offer no objection to a reasonable fee for grazing, but oppose a fee based on the rentals paid for comparable private range lands.

THE DEPARTMENT'S GRAZING POLICY

Although Congress has never enacted legislation dealing with grazing in the national forests, the department has always recognized forage as one of their important resources. Under its general authority "to regulate the occupancy and use of the national forests," a complete scheme of grazing administration has been built up by administrative regulation. The first object of its policy has been to provide for the fullest and most permanent use of the ninety-odd million acres of forage-bearing land in the national forests that is consistent with the preservation of the forage itself and with the protection of the timber, water, and other resources that must be safeguarded. Reductions in the number of livestock pastured and other adjustments of range use have been made from time to time to prevent overgrazing and to avoid injury to other resources. No other policy would have been consistent with the essential purposes for which the national forests were created; but this has not prevented a large and continuous use of the ranges with a minimum of disruption in the local livestock industry. The department has also sought to stabilize the contribution made by the national forests to the livestock industry of the Western States by a fair allocation of the grazing lands available between sheep and cattle and between individual permittees, and to build up the productivity of these mountain pastures through proper stocking and better methods of range management. It has pioneered in grazing research under open-range conditions and has sought to put into effect demonstrated betterments in the handling of the ranges as a

means of making them a more permanent and stable asset of the livestock industry.

The department has sought the fairest possible distribution of grazing privileges in which the old user has been protected as far as consistent with affording reasonable opportunity for the settler and small rancher to establish his home and develop his means of livelihood. The principle laid down by Secretary James Wilson in 1905, for the use of the range and other resources in the national forests, was that of the greatest good to the greatest number in the long run. It was felt that the settler who was engaged in developing from raw land a new farm unit contributing to the food supply and wealth of the Nation and who in this process needed the related use of national-forest grazing resources should be granted such use even though that necessitated a reduction in the privileges of the established occupants of the range. As a result of this policy the number of range users has increased since 1909 by nearly 25 per cent and the national-forest ranges now contribute to the maintenance of approximately 4,500,000 acres of cultivated land and 22,000,000 acres of grazing land in private ownership.

This policy has, of course, necessitated some reductions in the size of the herds grazed by old users in various localities; but that has been felt to be in line with the economic progress of the Western States. At the same time a system of preferences in the use of the national-forest ranges has been put into effect so that the established users of the range would be protected from arbitrary or drastic reductions and the whole industry given the greatest possible stability in its relationship to the national forests. In fact, the use of the national-forest ranges during the last 15 years has been more stable than the tenure of any other range areas in the West with the exception of a few of the very large private ranches.

It has been possible largely to accommodate the new settlers by taking up slack range voluntarily surrendered by old users, so that the extent of forced curtailments of former grazing privileges has, in the aggregate, been very small. For example, the intermountain district, comprising Utah, Nevada, and parts of Idaho and Wyoming, represents the region of most intensive demand for public range. This district supports about 40 per cent of all the cattle and horse permittees in the national forests, and 44 per cent of the sheep and goat permittees. It pastures 25 per cent of all the cattle and horses in the national forests and 43 per cent of all the sheep and goats. During the past 10 years the policy of range distribution followed by the department for the benefit of the new settler and small owner resulted in a reduction of 4 per cent of the cattle and 2.9 per cent of the sheep and goats grazed by the large operators.

STABILITY IN USE OF RANGES

The possibility of affording greater stability in the use of national-forest ranges has been given much study by the Forest Service. It is fully recognized that there are limits beyond which the curtailment of the established sheep and cattle outfits should not go, and that from the standpoint of the permanent welfare of the industry reasonable safeguards must be placed around the established and fully

developed livestock ranch. In cooperation with the permittees, this study led to the issuance of grazing permits for periods of 10 years, beginning with the season of 1925. These permits assure the holder that during the decade his use of the range will not be curtailed for any reason other than to protect forest resources against serious injury, with the exception that at the end of the first five years his herd may be reduced not more than one-tenth if necessary to provide room for new applicants qualified for a place in the national forests.

In many localities the settlement and development of agricultural land have progressed to the point where further subdivision of the range is unnecessary and, indeed, likely to be uneconomic. In these localities future use of the range can largely be stabilized in its present occupants. At other points, however, new agricultural developments will create a demand for range privileges from settlers who should be accorded the same opportunity to establish their homes as their predecessors have had in the past.

In 1906 the Department of Agriculture began charging fees for grazing in the national forests under a regulation of the Secretary which indicated that the rates would be advanced from time to time as the value of the range and the demand for it might warrant. The present fees, which were based roughly upon range values prevailing in the Western States in 1916, average approximately 12 cents per month for a cow and 3 cents per month for a sheep. Following a commitment made in 1920, when the charging of higher fees was seriously advocated in Congress, a detailed survey of the thousands of grazing allotments in the national forests was made by the Forest Service with a view to determining their physical characteristics as a means of arriving at the fair compensation which should be paid by the range user. An exhaustive study was also made of the rental value of private range lands in the Western States comparable to those in the national forests as fixed by leases holding over a long period of years. The results of this survey, which was completed in 1924, indicate that while the grazing fees paid on some of the national forests have been equal to or in excess of the actual value of the forage, on the ranges as a whole the present fees are less than the well-established value of similar private lands by at least 75 per cent. The free discussion of these figures among the grazing permittees and livestock associations of the West has led to a general protest from the industry against increasing the grazing fees and against a policy of "commercializing" the national-forest ranges.

Except where existing fees were found too high, the range appraisal report has not been approved by the Secretary of Agriculture. At the time of its completion the livestock industry was undergoing a severe depression, during which it was patent that no increased charges should be placed upon the producers who use the national forests. The reductions below existing fees shown to be required in equity to the permittees were made effective in 1925, involving a total decrease in annual grazing receipts of \$46,600. Otherwise all changes in grazing fees have been deferred until not earlier than 1927 in order to afford a further opportunity for the recovery of the livestock industry and also to permit a further check and review of the charges indicated by the appraisal. To

insure the careful consideration of this question from every angle I have designated as my personal representative Dan B. Casement, an expert of life-long experience in every phase of the livestock industry, to make an independent study of the whole subject.

GRAZING LEGISLATION DESIRABLE

The department believes that the production of livestock has a permanent and valuable place in the national forests, and that every reasonable form of security should be given the livestock producer in making the most advantageous use of this public resource. Legislation establishing a permanent place for grazing in the national forests would be desirable, in order that this important economic service may be freed from even the remote danger of sudden or drastic change in the more essential policies concerning the use of the range. It is my judgment, however, that any program for stabilizing grazing as a permanent feature of the national forests must square with the general interests of the public on certain points which are vital to the whole conception and plan of conserving natural resources.

In the first place, the use of the range must be subject to such control and adjustment as may be necessary to conserve and protect all of the resources in the national forests, including the forage itself, and this protection must be afforded through the direct supervision of the agencies responsible for the administration of the national forests as a whole. In the second place, although the stabilization of range use should be a primary feature of the policy, reasonable leeway must be retained for meeting the requirements of new settlement or land development where called for by the principle of the greatest public benefit. And in the third place, I believe that the use of the forage must rest upon a clean business basis of dealing with the public, with fair compensation for the value of the resource utilized, reasonably adjusted to current economic conditions in the livestock industry.

Vested property rights in national-forest range can not be harmonized with these requirements. It is possible, however, to further stabilize the grazing industry on the national forests by a program of legislation and administrative action which will provide for the permanent production and utilization of forage in the national forests as one of their major resources, with the licensing of livestock grazing on such areas in such numbers and under such systems of herding or management as in the judgment of the responsible administrative agencies will not injuriously affect the continuous production of forage, the regrowth of timber, the protection of watersheds, or other resources or lawful uses of national forest lands.

I favor a provision of law that will authorize firm contracts or licenses for periods of 10 years, to be binding upon the Government as long as their conditions are met, and under which the requirements to be observed by the range users, possible reductions in the numbers of livestock, and the provision for grazing fees shall be specifically set forth. Legislation of this nature will place the use of the national-forest ranges on the same footing of legal recognition and specific contract relations which now exists in the utilization of timber.

Other desirable features of stability in livestock production can be largely, if not wholly, provided by the department itself. The department favors the encouragement of individual grazing allotments wherever practicable, extending the policy already effective on many national forests, so that in connection with permits or contracts for 10-year periods the user of the range will have every inducement to improve his allotment and will reap the benefit of the betterments secured during the tenure of his permit. Where local economic conditions and the circumstances of land development warrant, the department favors restricting the further distribution of grazing privileges for the ensuing 10 years in order that greater stability may be secured by the established livestock producers and the desirable economic relationship between ranges and agricultural lands already developed may not be impaired. Elsewhere where land settlement or new development may require a further distribution of grazing privileges for the benefit of new users, this should be made within such equitable limits as will not cause undue hardship or necessitate an unwarranted readjustment of range operations by the established permittees.

It must be borne in mind that there can be no real stability of livestock production where overgrazing is causing a progressive decline in the carrying capacity of the range. A reasonable regulation of the grazing use, designed to bring about better methods of range and livestock management, has steadily strengthened the industry of the West and will continue to strengthen it. Such regulation must be continued. In the past it has had the support of a large proportion of the local livestock producers affected. The department believes in developing this phase of grazing administration more completely along the lines of local self-government by the livestock permittees directly concerned. To that end, a system of local boards, functioning for the national forests or the State, is believed desirable. Ordinary matters of local grazing management and range administration may thus be settled by the stockmen themselves in cooperation with local officers of the Forest Service. The numerous questions involved in the local adjustment of grazing are not susceptible of judicial determination. They should be dealt with on the ground in a cooperative spirit by practical range users and experienced grazing officers of the Forest Service. And in order that responsibility for the administration of the national forests and the conservation of their varied resources may not be divided, or antagonistic policies put into effect in different sections, it is believed imperative that a final determination, on appeal or otherwise, of all questions of a distinctly administrative nature, should rest with the head of the department. At the same time every user of the national forests should have ready access to the Federal courts for the determination of his rights under the law or of disputes arising in his contractual relations with the Government.

A program of greater stability for the livestock producers who use the national forests can readily be developed along these lines without imperiling the purposes and functions of the national forests. The essential point is that while the use of the ranges should be given a permanent and definite status and stabilized as far as pos-

sible, this use of the national forests must be fitted into and harmonized with the entire plan for the conservation of public resources.

During the past year 2,145,029 acres were covered by intensive range reconnaissance, making a total of 20,572,203 acres covered to date. This work involves a very careful survey of our grazing resources and provides the basic data necessary to the establishment of scientific methods of range management. There still remains to be covered nearly four-fifths of the total area of range lands before the work will be complete. It is, however, through work of this character that real stability of range use, based on realization of the highest productivity that the resource permits, will ultimately be attained.

REFORESTATION

Reforestation has come to signify in popular acceptance whatever looks toward the establishment of a new timber crop, whether by natural reproduction from the old stand or by tree planting, and whether the new crop succeeds the harvested one or restores tree growth on deforested and idle land. In this broad sense reforestation has made great progress during the past year.

Timber growing on the vast area—about one-fourth of the total land surface of the United States—better adapted to this than to any other form of use, is bound to come in time through the slow working out of purely economic forces. Its nation-wide adoption in place of timber mining, however, is still remote, and many obstacles lie in the path. The public must take a hand in hastening reforestation, or suffer during an unnecessarily protracted transition period. In face of the evils of increasing timber shortage and declining productiveness of forest lands it is urgently important to press the work forward.

It can safely be said that never before has the forest problem of the country been so much to the fore in the public mind. Further, there is increasing disposition to act on it; and there is an increasingly intelligent conception of what it really is. Nevertheless, the public does not yet see clearly and fully what ought to be done. It is largely groping in the dark.

There is need for leadership; there is need for much more in the way of public education, to the end that what is done may be intelligently done; there is need for creating a far greater body of knowledge than is now in existence, both to guide public policy and to shape private practice; and there is need not only to develop this knowledge but also to diffuse it in effective and manifold ways, so that it may actually reach and be used by those who will profit by it. All these needs are being met by the Forest Service to the extent of its resources, yet inadequately in comparison with what should be done.

In the forest industries there is taking place a very marked change of attitude toward reforestation. It is of real significance, but its interpretation must not be too hastily made. Powerful economic forces are beginning to create a distinct trend toward a new basis organization of these industries; yet many conflicting forces are at

work, and it would be a serious mistake to assume that a radical transformation is about to take place. Nevertheless, the process of conversion is under way.

The lumber industry, the naval-stores industry, and the pulp and paper industry are outstanding examples. In all of them serious thought is being given to timber growing as the source of raw material. Individual companies in considerable numbers are actually making investments with this end in view. Some are definitely embarked on enterprises that contemplate permanency based on sustained timber yields from their own lands under forest management. On the Pacific coast, in the southern pineries, and, most of all, in the Northeast, forestry has unquestionably gained a substantial foothold.

It is essential that this movement toward the practice of forestry on the part of landowners and industries be facilitated in every possible way. One way is through obtaining and communicating to them better knowledge of the methods that they should employ, of the returns that can be realized through use of these methods, and of the relative costs of improved and current practices. Another way is through public cooperation in the form of organized fire protection and tax reform, both of which necessitate State action. The Federal Government is now in position, through the provisions of the Clarke-McNary law, to extend help to those States which wish to receive this help. The largest immediate need in forestry is for State movements based on a clear conception of the forest situation and requirements in each State, to bring about the adoption of forest policies that will accelerate the trend now unquestionably perceptible toward timber growing as a voluntary private enterprise. Here again there is opportunity for the Forest Service to contribute much of value in leadership and knowledge obtained through research.

BETTER UTILIZATION OF TIMBER

The traditional methods used in harvesting timber and working it into useful articles cause enormous losses of wood—partly inevitable, partly avoidable—at every stage from forest to consumer. The quantity of wood so lost is in fact greater than the quantity used. As a reduction of these losses would relieve the heavy drain on our forests, it is obvious that economy in wood utilization is an important phase of conservation and should have in the forestry movement a place equal to timber growing. We need not only to grow timber but to learn to use wisely what we now have and what we shall grow in the future.

Recognizing that the public and the forest industries have an equal interest in reducing waste, the late Secretary Wallace called a national conference on the utilization of forest products, which met in Washington in November, 1924. At this conference over 400 representatives of the timber-producing and timber-consuming industries, together with foresters and engineers, formulated a program of attack on timber waste, principally through an organized and voluntary effort by industry aided by the Government to improve the methods of manufacturing, marketing, and using forest products.

As recommended by this conference, a national committee on wood utilization has been formed under the leadership of the Department of Commerce with the support and participation of the Forest Service. This committee, acting as a coordinating and steering body to various timber-producing and consuming associations, will closely parallel in organization and methods the central committee on lumber standards, which is dealing so successfully with the intricate problem of standardizing lumber grades and specifications. The committee on wood utilization will seek to deal with like problems that offer an opportunity to make conspicuous reductions in waste. This movement, promising as it does to prolong our timber supply and give greater security to the public and to the industries dependent on that supply, is a striking example of a great industrial reform undertaken through intelligently directed effort by the business group immediately concerned.

FOREST ROAD AND TRAIL BUILDING

During the past fiscal year 1,800 miles of roads and 4,085 miles of trails within and adjacent to the national forests were constructed at a total cost of \$12,834,738 Federal funds and \$2,291,325 cooperative State and county funds. The first appropriation for the construction by this department of national-forest roads and trails was made by the act of August 10, 1912, under which 10 per cent of the national-forest receipts was made available for this purpose. The total that has been appropriated, under various acts, expressly for the same purpose, has been \$50,591,149. Of this amount \$44,179,226 has been expended in cooperation with \$12,740,135 appropriated by States and counties. The expenditures made to the close of the fiscal year 1925 have resulted in the construction of 10,022 miles of forest roads and 21,497 miles of forest trails and the maintenance of 13,978 miles of forest roads and 38,858 miles of forest trails.

The roads constructed from these forest road appropriations are two kinds, expressly defined by Congress in section 23 of the Federal highway act of November 9, 1921: those required for the administration, protection, and development of the national forests, called forest development roads, and those required to complete the State and county systems when they traverse or adjoin the national forests, called forest highways. The law expressly stipulates the method by which these two funds are to be apportioned to the States containing national forests. The forest development fund is apportioned according to the relative needs of the forests, taking into consideration existing transportation facilities, value of timber and other resources to be served, relative fire danger, and comparative difficulties of road and trail construction. The forest highway fund must be apportioned according to the area and value of the national-forest lands.

IX. DEPARTMENT OF AGRICULTURE: FEDERAL-AID ROADS

A greater mileage of Federal-aid roads was completed during the fiscal year 1925 than in any previous year. The aggregate length of the projects completed was 11,329 miles, and the largest previous

year's record was less than 10,000 miles. This addition brings the mileage completed since 1917 up to a total of 46,486.

In addition to this completed mileage, which includes only the projects that are entirely completed, there were under construction at the close of the fiscal year other projects the aggregate length of which was 12,463 miles. A very considerable portion of this mileage is actually completed, but will not be so reported until the projects in which it is included are completed in their entirety.

The total cost of the projects completed during the year was approximately \$243,000,000, of which approximately \$111,000,000, or more than 45 per cent, was paid by the Federal Government. The cost of the entire mileage completed from 1917 to date has been more than \$845,000,000, and the Federal Government has paid of this total approximately \$373,000,000.

This total Federal expenditure over the nine-year period has been large enough to make the Federal participation effective without necessitating extravagant expenditures of State funds to meet it. As the Federal excise taxes on motor vehicles, tires, and motor-vehicle accessories have produced since 1918 Federal revenues amounting to \$800,000,000, it may be seen that the Federal-aid highway expenditures have been far more than paid by owners of motor-vehicles. The same motor-vehicle owners contributed to the State treasuries in license fees and gasoline taxes during the last fiscal year more than sufficient funds to pay the States' share of the cost of the Federal-aid roads in all States with the exception of New Mexico.

In the roads completed during the year all approved types of construction are represented. Gravel roads, of which there were 4,203 miles, constitute the largest single class. The completed mileage of all types was as follows:

	Miles completed
Graded and drained earth roads.....	2,064
Sand-clay roads.....	719
Gravel roads.....	4,203
Water-bound macadam roads.....	129
Bituminous macadam roads.....	912
Bituminous concrete roads.....	341
Portland cement concrete roads.....	2,807
Brick roads.....	107
Bridges (over 20 feet in span).....	47
Total	11,329

One of the most important projects recently completed is the Wendover cut-off across the Great Salt Lake Desert between Salt Lake City and the Nevada line. The completion of this road brings to a successful conclusion a five-year effort to bridge the obstacle to transcontinental travel which has always been presented by the salt desert. Its construction could not have been undertaken but for the financial assistance offered by the Federal Government; and the flow of interstate travel which has already begun between Salt Lake City and northern and central California is one of the outstanding evidences of the necessity for Federal participation with the States in interstate highway construction.

ROAD-MARKING SYSTEM

As an outgrowth of the designation and improvement of the Federal-aid highway system and the several State highway systems, and in recognition of the rapidly increasing interstate highway traffic, the joint board on interstate highways has designated a system of main interstate and transcontinental highways and has devised uniform danger and direction signs for the marking of the designated highways in all States.

The various routes will be indicated by numbers, and the numbering will be continuous on each route in all States through which it passes. The roads included in this system are parts of the Federal-aid highway system. Their improvement is thus assured at an early date; and their uniform marking in accordance with the standards established by the joint board will add greatly to their value and service as interstate and transcontinental arteries. The board was appointed in February, 1925, by Secretary Gore at the suggestion of the American Association of State Highway Officials. Its membership includes State highway officials and representatives of the Bureau of Public Roads.

The highway traffic surveys conducted by the Bureau of Public Roads in cooperation with officials of the States of Connecticut, Maine, Pennsylvania, Ohio, California, and Cook County, Ill., have already produced information of great importance as a basis for the scientific planning of highway improvements and the control of traffic.

DEMAND FOR HIGHWAY SERVICE

The demand for highway service varies greatly on different roads. Recognizing this condition, it is the purpose of the traffic surveys to reveal the relative density and weight of traffic on all highways of the State or county system as an index of the degree of improvement required and justified by the traffic and as a guide to the equitable allocation of available revenues. These are fundamental decisions which must be made by every State highway department and all other authorities in control of the highways, and they are decisions which can be rationally made only on the basis of the relative traffic demands. In these respects the surveys thus far undertaken have had results of the highest practical value.

Of the 681 miles of major national-forest roads completed during the last fiscal year, 635 miles were in the States of the far West and the Territory of Alaska. Although the work of forest-road construction is overshadowed in the eyes of the public generally by the more extensive Federal-aid work, its importance is fully realized by the people of the West, and in the great territory west of the one hundred and third meridian it is in fact no less important than the bigger work. Occupying the crests of the mountain ranges the forests control all the more important highway passes. They practically surround and control access to the national parks; and they interpose between sections of all the Western States virtually continuous bands of national land, in which the highways, if they are to be improved at all, must be improved by the Federal Government. The improvement of the major forest roads is, therefore,

not only of vital concern to the States in which they are located but is of importance to the Nation as a whole, since it is essential for the accommodation of interstate and transcontinental traffic.

X. DEPARTMENT OF AGRICULTURE: INSULAR EXPERIMENT STATIONS

The department maintains agricultural experiment stations in Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands. In Alaska it is seeking to develop a type of agriculture for that region that will supplement the development of other industries. In Hawaii and Porto Rico it is trying to diversify the agriculture of those territories, at present centered very largely on cane-sugar production. In Guam an effort is being made to improve agricultural practices and to restore agriculture to its former important position. In the Virgin Islands the problem has been to show how diversified agriculture may improve the disturbed economic conditions of those islands and furnish employment for many who formerly were engaged in other industries that are now in need of fewer laborers.

In Alaska homesteads are being acquired and former prospectors, miners, and fishermen are turning to agricultural pursuits to supply local demands for products. The stations through their plant-breeding work have developed varieties of wheat, barley, and oats than can be depended upon to mature in average seasons in the interior of the Territory. Hybrid strawberries have been produced that are hardy in most parts of the country and they are being extensively grown for home consumption and for market. New varieties of potatoes have been developed that surpass in yield and quality any of the varieties grown in Alaska that are standard elsewhere.

Considerable attention has been given to livestock, and Galloway cattle have been found adapted to the rigorous winter climate of southwestern Alaska. In order to obtain higher milk yields and still retain the vigor of the beef type reciprocal crosses have been made between the Galloway and Holstein breeds, and some of the second-generation animals are now in milk. Their production is intermediate between that of the best Holsteins and the best Galloways of the herd, and the average percentage of butterfat in their milk is considerably higher than that of the Holstein cows. The crossbred animals stay with the Galloways during stormy weather, while the Holsteins seek shelter. For the interior of Alaska the Fairbanks station is trying to develop a beef animal that will withstand the winter's cold without undue sheltering and feeding, and it now has three calves resulting from crossing the Asiatic yak with Galloway cows. Crosses between yak and domesticated cattle are common in Mongolia, and it is believed they will prove of value in the interior of Alaska.

PROGRESS IN HAWAII

The Hawaii station, from its establishment, has worked for the diversification of agriculture in those islands and the development of new industries. That it has been successful to a gratifying degree is shown in the changed practices and larger production of a number of

commodities. Through the station's efforts the methods of rice growing have been changed, and now the oriental growers fertilize their crop with ammonium sulphate instead of with nitrate of soda, and the cost of production is lowered and the yield increased. Soon after the establishment of the experiment station attention was given to a diseased condition of pineapples that was threatening that crop. The trouble was found to be due to large quantities of manganese in the soil, making iron unavailable to the pineapple plant. By the simple expedient of spraying the plants three or four times a year with a solution of iron sulphate perfect crop production is assured, and more than 10,000 acres of land that had been abandoned has been planted to pineapples again, and this crop has become second in importance to sugar production, the export of canned pineapples in 1924 amounting to about \$28,000,000.

Attention was given quite early to the improvement of stock ranges, and many valuable forage plants were introduced and established. One of the outstanding achievements was the introduction of the pigeon pea, which was obtained from the Porto Rico experiment station. This has proved such a valuable acquisition for feeding and fattening all kinds of stock that more than 10,000 acres have been planted for those purposes. It has been found also to be an excellent crop to rotate with pineapples, improving the soil very greatly.

The station is engaged at present in developing a starch industry from the edible canna. This plant grows readily on lands not adapted to sugar cane or pineapples and in no way competes with them. Some technical details of manufacturing remain to be worked out, but one factory has already begun the commercial production of the starch.

When the mosaic disease of sugar cane appeared to threaten the destruction of the sugar industry of Porto Rico, the experiment station found among its varieties the Uba or Japanese cane, that was but little affected by the disease. Through the Bureau of Plant Industry of the department additional supplies of this variety were obtained and disseminated to the worst-affected districts, and it is now being extensively grown. This variety has some undesirable qualities, and through plant-breeding experiments other resistant varieties are being obtained that will soon replace it. A testimonial signed by 30 planters was recently presented the station in acknowledgment of their gratitude to it.

TICK ERADICATION IN PORTO RICO

The first dipping tank for use in the eradication of the cattle tick in Porto Rico was constructed at the station, and as a result of its successful use there are now about 200 public and private vats on the island, and the time is believed to be soon at hand when the island will be free of this menace to the cattle industry. Following the clearing of the station grounds of ticks, dairying was taken up, and through the introduction of purebred sires a valuable high-grade herd has been developed that is serving as an example to many ranchers and milk is becoming more available for the diet, especially of children.

The station has given much attention to the introduction of improved varieties of agricultural and horticultural crops, and many

of its introductions have become important factors in the life of the people.

When the Guam experiment station was established agricultural production had fallen to a low state and the problem was to restore it and develop it along modern lines. Agricultural practices were very primitive and the livestock of the island had degenerated through inbreeding until all kinds were in a deplorable condition. Immediate attention was given to the improvement of livestock through the introduction of purebred animals, and remarkable results have been obtained, especially with swine and poultry. This was accomplished very largely through the organization of boys' and girls' clubs, and high-grade pigs and chickens, as well as many purebred ones, are now to be found throughout the island. Connected with livestock work was the introduction of forage and pasture plants, and a number have been established to take the place of inferior native plants.

Copra is the only export of importance and it is the main money crop of the island. The station has greatly improved the quality produced and a higher price is now obtained for all that is produced. Unfortunately the coconut scale (*Aspidiotus destructor*) has made its appearance on the island, having been found in destructive abundance in December, 1923. This scale has practically destroyed all the coconut plantations on Saipan, an island 120 miles north of Guam. Energetic measures were undertaken under the direction of the station, and much good was accomplished in checking its ravages. Under special appropriations from Congress a campaign for the control of the scale was begun late in the last fiscal year. In addition to the coconut the scale in Guam also infects many other important economic plants.

FOOD CROPS IN VIRGIN ISLANDS

The Virgin Islands experiment station, which is located on the island of St. Croix, was obtained through the cession of those islands by Denmark in 1916. Economic changes have been so great in the Virgin Islands that agriculture is about the only important industry that is left. The experiment station is endeavoring to improve agriculture in all its phases, but it is paying particular attention to the growing of food crops to supply local needs as well as to provide employment to persons who were deprived of their usual occupations by changed conditions. Attention is being given to livestock problems as cattle raising is second only to sugar production.

Porto Rico offers a good market for cattle, and investigations have been begun in breeding up and feeding the native stock. New forage plants have been successfully established and they are being distributed rapidly. Vegetable growing has received quite an impetus, and local supplies are more numerous than formerly. A very successful experiment in growing Bermuda onions for local use as well as for shipment to New York has just been concluded, and as an outcome of the experiment a Bermuda onion growers' association has been formed.

One of the outstanding achievements of the station is its variety of sugar cane known as SC 12/4. This variety, originated several

years ago as a seedling, has proved valuable for conditions resembling those of St. Croix where cane is grown without irrigation. It has been given extensive trial in the Virgin Islands, Porto Rico, and Cuba, and is highly commended not only on account of its high tonnage of cane, but also of the outturn of sugar and the comparative freedom from injury by the mosaic disease.

XI. DEPARTMENT OF AGRICULTURE: PUBLICATIONS AND PRESS WORK

The informational work of the department was consolidated under one head on May 1, 1925. The Office of Information, which was reestablished at that time, includes all publication, press service, and radio work, either within itself or under the supervision of the director. During the past year the department issued a total of 5,374,000 copies of new publications exclusive of periodicals, of which 2,314,000 were Farmers' Bulletins. In addition, nearly 15,000,000 copies of various publications were reprinted, about 9,500,000 of them being Farmers' Bulletins for popular distribution. Economies in printing have helped in a measure to meet the demand for publications with a smaller appropriation. In an effort to prevent waste distribution, the practice of sending publications to large mailing lists has been stopped and instead inexpensive announcement cards, calling attention to the new publications, are sent out. It is estimated that this method has saved many thousands of publications and has resulted in getting bulletins only to those persons most interested in them.

Releases of mimeographed stories for the press during the year numbered 1,062. In addition, there were 103 issues of mimeographed material for the use of radio broadcasting stations and 52 issues of a printed weekly Clip Sheet for the use of newspapers. The Office of Information has improved its contacts with newspapers, press associations, and the farm and trade press through various means. A study of the several hundred publications of various kinds indicates a large increase in the use of department material by all classes of newspapers, magazines, and trade journals.

It appears to me that the press has been noticeably receptive to all information of a scientific and an economic nature. This tendency has been of the utmost value to the department in carrying on its work, which consists mainly in acquiring new facts which are of value only when they have been brought to the attention of persons who can apply them—on farms, in factories, and in the home.

Respectfully,

W. M. JARDINE,
Secretary of Agriculture.

XII. FINANCIAL STATEMENT

EXPENDITURES, DEPARTMENT OF AGRICULTURE, FISCAL YEAR 1925

Expenditures for work under the supervision of the Department of Agriculture during the fiscal year which ended June 30, 1925, including road building, totaled \$164,395,010.04, classified as follows:

Expended and obligated, fiscal year 1925

(1) For regular work of department (activities with whose execution the department is directly and independently responsible), as follows:		
Office of the Secretary-----		\$894,996.70
Division of Accounts and Disbursements-----		72,582.62
Office of Publications-----		1,090,197.12
Office of Experiment Stations-----		1,333,491.50
Extension Service-----		1,576,467.91
Weather Bureau-----		2,291,652.77
Bureau of Animal Industry-----		11,839,854.88
Bureau of Dairying-----		508,544.71
Bureau of Plant Industry-----		3,719,037.47
Forest Service-----		9,503,015.13
Bureau of Chemistry-----		1,463,058.57
Bureau of Soils-----		382,875.15
Bureau of Entomology-----		2,174,680.15
Bureau of Biological Survey-----		913,327.10
Library-----		70,754.96
Bureau of Public Roads-----		464,154.62
Bureau of Agricultural Economics-----		4,777,126.73
Bureau of Home Economics-----		105,551.57
Insecticide and Fungicide Board-----		173,887.51
Federal Horticultural Board-----		707,092.31
Packers and Stockyards Administration-----		441,633.78
Grain Futures Administration-----		91,234.71
Fixed Nitrogen Research Laboratory-----		241,454.09
Farmers' Seed Grain Loans-----		71,891.99
Total expenditures for regular work-----		43,908,614.05
(2) For work administered by department, supported by Federal funds provided as direct aid to States or for special forestry conservation work and similar objects, as follows:		
(a) Special conservation items		
(Weeks law of Mar. 1, 1911)---		
Cooperation with States in fire protection of forested watersheds of navigable streams-----	\$399,260.17	
Acquisition of lands for protection of forested watersheds of navigable streams-----	834,678.45	
		\$1,233,938.62
(b) Colleges and stations---		
Payments to State agricultural experiment stations for research work (Hatch and Adams Acts funds)-----	1,440,000.00	
Payments to State agricultural colleges for extension work in agriculture and home economics (Smith-Lever Act funds)-----	5,880,000.00	
		7,320,000.00
(c) Road construction (Federal-aid road act of July 11, 1916, as amended and supplemented)---		
Payments to State highway departments for cooperative construction of Federal-aid highway system-----	97,497,976.41	
Forest roads and trails-----	9,989,694.29	
		107,487,670.70

¹ Including \$2,730,845.96 paid to livestock owners as indemnities for animals destroyed in connection with tuberculosis and foot-and-mouth disease eradication.

(2) For work administered by department, etc.—Continued.

(d) Forest Service receipt funds—

Payments to States for benefits of local roads and schools— \$1, 346, 352. 09

Roads and trails for States— 518, 689. 30

Cooperative work, consisting principally of forest road and trail construction (paid from contributions from private sources)----- 2, 475, 852. 14

Refunds to users of national forest resources of moneys deposited by them in excess of amounts required to secure purchase price of timber, use of lands, etc----- 103, 894. 09

\$4, 444, 787. 62

Total expenditures for work administered by department (other than regular work)----- \$120, 486, 396. 94

Total expenditures for regular activities of and work administered by department----- 164, 395, 010. 04

FEDERAL FUNDS FOR REGULAR WORK

As indicated by the foregoing table, the total expenditures for the regular or ordinary work of the department during the fiscal year 1925 amounted to \$43,908,613.10. Partially offsetting this figure, earnings in connection with these activities during the year, amounting to \$5,306,392.72, deposited in the Treasury of the United States to the credit of "miscellaneous receipts," and \$198,372.98 received as fees for classifying cotton and credited to the revolving fund for that purpose, make the actual net cost to the Federal Government of the department's regular work \$38,403,848.35.

Of the total expenditure of \$43,900,000 for regular work, approximately (1) \$10,000,000, or 23 per cent, was used for research, including investigations and experiments in animal and plant production, breeding and improvement, in methods of controlling diseases, insects, and other animal and plant pests, for soil studies, for the investigation of farm management, marketing, and crop utilization problems, and other scientific studies and investigations of the fundamental problems of agriculture, horticulture, forestry, etc., by means of laboratory and field experiments; (2) \$2,400,000, or 5.5 per cent, for extension work—that is, demonstration and educational work by means of county agricultural agents, through exhibits, motion pictures, or otherwise, with a view to the dissemination of the information developed by the experiments and discoveries of the department and the various States; (3) \$8,600,000, or 19.6 per cent, for the direct eradication or control of plant and animal diseases, insects, and other pests; (4) \$9,500,000, or 21.6 per cent, for the administration of regulatory laws, such as the food and drugs act, the meat inspection law, the migratory-bird treaty act, the grain standards act, the warehouse act, and other laws, some 30 or more in number, with the enforcement of which the Department of Agriculture is charged; and (5) \$13,300,000, or 30.3 per cent, for service work, including such activities as the administration and protection of the national forests, the weather service, crop and livestock estimating, market news service, shipping point and terminal market inspection service on perishable farm products, and other work of like character for the benefit of the public, not primarily involving research or the enforcement of special laws of a regulatory nature.

**FEDERAL FUNDS ADMINISTERED BY DEPARTMENT FOR ACTIVITIES
OTHER THAN REGULAR WORK**

As shown in the above table, of the total expenditure of \$164,400,000 charged against the Department of Agriculture for the fiscal year 1925, approximately \$120,500,000 constituted funds administered by the department but not used for the prosecution of its regular or ordinary activities. The larger part of this amount, or about \$107,500,000, consisted of Federal aid to States for highway construction and for forest roads and trails; \$7,300,000 was the Federal contribution to State agricultural colleges and experiment stations for research and extension work under the Hatch, Adams, and Smith-Lever Acts; \$4,500,000 (consisting of receipts derived from business on the national forests and funds contributed by Forest Service cooperators) was used principally for local road and school purposes; and \$1,200,000 was applied to special forest conservation work, under the Weeks law, including the purchase of additional forest lands and cooperation with States in the protection of State and private timberlands against fire.

**INCOME TO GOVERNMENT IN CONNECTION WITH DEPARTMENT'S
ACTIVITIES, FISCAL YEAR 1925**

Incident to the department's work during the fiscal year 1925 direct receipts aggregating \$9,214,322.72 were covered into the Treasury and fines were imposed and judgments recovered by the courts amounting to \$176,804.45 in connection with the enforcement by the department of the regulatory laws which devolve upon it for administration and execution, as follows:

RECEIPTS	
Deposited to credit of miscellaneous receipts fund:	
Regular work—	
From business on the national forests.....	\$4, 502, 955. 92
From other sources.....	803, 436. 80
	<hr/> \$5, 306, 392. 72
Work administered (other than regular work)—	
Ten per cent of net receipts from business on the national forests, appropriated as a special fund for forest road and trail construction in 1926.....	497, 181. 57
Contributions from private cooperators, appropriated as a special fund and used mainly for the construction of forest roads and trails.....	2, 104, 219. 23
Proceeds from sale of surplus war materials transferred to States for road-construction work.....	130, 924. 72
	<hr/> 2, 732, 325. 52
Total receipts deposited to credit of miscellaneous receipts fund.....	<hr/> \$8, 038, 718. 24

Deposited to credit of applicable appropriations
and funds of department:

Fees collected for classifying cotton, deposited to credit of revolving fund for conducting this work-----

\$198, 372. 98

Reimbursement to various appropriations of department for expenditures made therefrom-----

977, 231. 50

\$1, 175, 604. 48

Total receipts-----

\$9, 214, 322. 72

FINES

Fines imposed and judgments recovered by the courts in connection with violations of statutes intrusted to Department of Agriculture for enforcement-----

\$176, 804. 45

Total direct income to Government resulting from activities of Department of Agriculture-----

\$9, 391, 127. 17,

XIII. REVIEW OF AGRICULTURAL PRODUCTION AND EXPORTS

Acreage of crops in the United States

Crop	Annual acreage, 1910-1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924 ¹	1925 ²
CEREALS												
Corn.....	1,005,240	1,066,197	1,055,296	1,116,730	1,004,467	1,097,170	1,001,699	1,003,740	1,002,846	1,004,324	1,005,012	1,006,621
Wheat.....	48,953	60,469	52,316	45,689	59,181	75,994	61,143	63,696	62,317	59,659	54,209	53,994
Oats.....	38,014	40,996	41,527	43,553	44,349	40,359	42,491	45,495	40,790	40,981	42,452	44,467
Barley.....	7,593	7,148	7,757	8,933	9,740	6,720	7,600	7,414	7,317	7,835	7,086	8,826
Rye.....	2,305	3,129	3,213	4,317	6,391	6,307	7,409	4,528	6,472	5,171	4,173	4,824
Buckwheat.....	826	769	828	924	1,027	700	701	680	764	739	816	823
Rice.....	733	803	869	981	1,119	1,063	1,336	921	1,055	895	892	998
Grain sorghums.....	---	4,153	3,944	5,153	6,036	5,090	5,120	4,635	5,064	5,792	5,085	5,234
Total.....	203,664	223,664	215,750	225,680	232,310	233,073	224,499	231,109	226,825	225,396	219,725	225,147
VEGETABLES												
Potatoes.....	3,686	3,734	3,565	4,384	4,295	3,542	3,657	3,941	4,307	3,816	3,662	3,453
Sweet potatoes.....	611	731	774	919	940	941	992	1,066	1,117	993	938	1,014
Beans (commercial).....	---	928	1,107	1,821	1,744	1,060	847	777	1,079	1,320	1,376	1,584
Onions (commercial).....	---	---	---	64	65	53	65	57	63	62	60	57
Cabbage (commercial).....	---	---	---	93	116	96	124	105	134	105	110	106
Total.....	4,297	5,393	5,446	7,281	7,160	5,692	5,685	5,946	6,700	6,296	6,146	6,214
MISCELLANEOUS												
Cranberries (3 States).....	23	23	26	18	25	25	25	25	25	28	28	28
Flaxseed.....	2,402	1,957	1,474	1,984	1,910	1,503	1,757	1,108	1,113	2,014	3,289	3,093
Sugar beets.....	498	611	665	695	594	692	872	815	530	957	817	776
Tobacco.....	1,209	1,370	1,413	1,518	1,647	1,951	1,960	1,427	1,695	1,877	1,720	1,693
All hay.....	66,350	67,904	72,366	71,415	71,120	74,038	73,888	74,401	77,030	75,424	76,385	74,796
Cotton.....	35,330	31,412	34,985	33,841	36,008	33,566	35,878	30,669	33,036	37,123	41,360	46,448
Sorghum cane for sirup.....	---	---	---	415	422	487	536	518	447	380	404	397
Peanuts.....	---	1,043	1,845	1,842	1,865	1,132	1,181	1,214	1,005	896	966	909
Broomcorn.....	---	230	235	345	366	352	352	222	275	536	442	191
Clover seed.....	---	---	989	821	820	942	1,052	889	1,170	775	747	---
Grand total.....	313,756	331,994	334,333	345,825	354,247	353,453	347,639	349,183	349,861	351,402	352,049	350,692

¹ Subject to revision in December.² Preliminary, Oct. 1.³ Acreage under cultivation June 25.⁴ Not including acreage for clover seed, for which no estimate is yet available.

Crop production in the United States

Crop	Annual average 1910-1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924 ¹	1925 ²
		Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands	Thousands
CEREALS												
Corn..... bushels	2,732,457	2,994,793	2,566,927	3,065,233	2,502,665	2,811,302	3,208,584	3,068,569	2,906,020	3,053,557	2,436,513	2,917,886
Wheat..... do	728,225	1,025,801	636,318	636,655	921,438	967,979	833,027	814,905	867,988	797,381	872,673	697,272
Oats..... do	1,157,961	1,549,030	1,251,837	1,528,124	1,528,124	1,184,031	1,496,281	1,078,341	1,215,883	1,305,883	1,541,900	1,470,384
Barley..... do	186,208	228,851	182,309	211,759	256,225	147,008	189,332	154,046	182,068	197,691	187,875	226,766
Rye..... do	37,568	54,050	48,862	62,933	91,041	75,483	60,490	61,075	103,362	63,077	63,446	51,968
Buckwheat..... do	17,022	15,056	11,662	16,022	16,905	14,399	13,142	14,207	14,564	13,965	15,956	15,823
Rice..... do	24,378	28,947	40,861	34,739	38,606	41,985	52,066	37,612	41,405	33,717	33,956	35,810
Grain sorghums..... do		114,460	53,858	61,409	73,241	130,734	137,408	113,990	90,524	105,835	114,231	102,056
Total.....	4,883,819	6,010,988	4,792,634	5,681,490	5,438,245	5,373,520	5,990,330	5,344,245	5,421,344	5,571,106	5,266,550	5,517,935
VEGETABLES												
Potatoes..... bushels	360,772	359,721	286,953	442,108	411,860	322,867	403,296	361,659	453,396	416,105	454,784	344,227
Sweet potatoes..... do	57,117	75,639	70,955	83,822	87,924	97,126	103,925	98,654	109,394	97,177	71,861	74,337
Beans (commercial)..... do		10,321	10,715	16,045	17,397	13,549	9,185	9,150	12,793	16,004	13,619	17,754
Onions (commercial)..... do		7,664	8,562	19,138	19,423	14,548	21,543	14,165	18,763	17,306	17,627	16,948
Cabbage (commercial)..... tons		671	255	475	583	646	1,105	687	1,089	806	973	845
FRUITS												
Peaches..... bushels	45,842	64,097	37,605	48,765	33,094	53,178	45,620	32,602	55,852	45,352	53,137	47,780
Pears..... do	11,184	11,216	11,874	13,281	13,362	15,006	16,805	11,297	20,705	17,845	18,628	18,164
Apples..... do	197,898	230,011	193,905	166,749	169,625	142,086	223,677	99,002	202,702	202,842	179,101	164,042
Cranberries (3 States)..... barrels		441	471	249	352	549	449	384	560	652	562	567
MISCELLANEOUS												
Flaxseed..... bushels	18,353	14,030	14,296	9,164	13,369	7,178	10,752	8,029	10,375	17,060	30,173	23,223
Sugar beets..... tons	5,391	6,511	6,228	5,980	5,949	6,421	8,538	7,782	5,188	7,006	7,513	6,547
Tobacco..... pounds	991,958	1,062,237	1,153,278	1,249,276	1,439,071	1,465,421	1,582,225	1,069,693	1,246,837	1,515,110	1,240,513	1,228,972
All hay..... tons	81,640	107,263	110,992	98,439	91,139	104,760	105,315	97,770	112,013	106,611	112,450	98,135
Cotton..... bales	11,259	11,192	11,450	11,302	12,041	11,421	13,440	7,954	9,762	10,140	13,628	14,769
Sorghum sirup..... gallons	14,974	14,823	13,668	37,472	33,387	39,413	49,605	45,666	36,440	32,001	27,339	26,161
Peanuts..... tons		919,028	1,432,681	1,240,102	783,273	841,474	829,307	633,114	647,762	616,200	581,331	581,331
Broomcorn..... tons	52		39	57	62	53	36	38	37	81	76	28
Clover seed..... bushels			1,706	1,488	1,197	1,484	1,944	1,538	1,955	1,228	977	

¹ Subject to revision in December.² Preliminary, Oct. 1.

Exports of domestic foodstuffs and cotton from the United States

[Foreign Commerce and Navigation of the United States, 1910-1918, and monthly summaries of the Bureau of Foreign and Domestic Commerce, June, 1921, 1922, 1923, 1924, and 1925]

Article exported	Unit	Average 1910-1914	Year ended June 30—										
			1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
		<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>	<i>Thou- sands</i>
Wheat, including flour	Bushel	104,967	332,465	243,117	203,574	132,579	257,402	219,865	366,077	279,407	221,923	156,430	258,023
Corn, including meal	do.	41,400	50,668	39,897	66,753	49,073	23,019	16,729	70,906	179,490	96,596	23,135	9,791
Oats, including oatmeal	do.	9,655	100,609	98,960	95,106	125,091	109,005	43,436	9,391	21,237	25,413	8,796	16,777
Barley, excluding flour	do.	7,896	26,755	27,473	16,381	26,285	20,458	26,571	20,457	22,400	18,193	11,209	23,653
Rye, including flour	do.	888	13,027	15,250	13,703	17,186	36,467	41,531	47,337	29,944	51,663	19,902	50,242
Rice, including flour, meal, and broken rice.	Pound	18,489	75,449	120,695	181,372	196,363	193,128	483,385	440,855	741,509	370,670	227,757	112,037
Dairy products:													
Butter	do.	4,278	9,851	13,487	26,835	17,736	33,740	27,156	7,829	7,512	9,410	5,425	8,384
Cheese	do.	4,915	55,363	44,394	66,050	44,303	18,792	19,378	10,826	7,471	8,446	3,938	9,432
Milk, condensed, evaporated, and powdered.	do.	15,774	37,236	159,578	259,141	528,759	728,740	710,533	266,506	288,629	159,957	216,319	179,170
Total dairy products	do.	24,967	102,450	217,459	352,026	590,798	781,272	757,067	285,161	303,612	177,812	225,682	196,986
Meat and meat products:													
Pickled beef	do.	32,873	31,875	38,114	58,054	54,468	45,065	32,384	23,313	26,774	24,185	21,851	22,407
Fresh beef	do.	29,452	170,441	231,214	197,177	370,033	332,205	153,561	21,084	3,993	4,017	2,817	3,144
Canned beef	do.	9,392	75,243	50,804	67,536	97,343	108,460	31,133	10,763	3,749	2,312	1,545	1,835
Total beef	do.	71,717	277,559	320,132	322,767	521,844	485,730	217,078	55,160	34,516	30,514	26,213	27,386
Bacon	do.	182,474	346,718	579,809	607,152	815,294	1,238,247	803,667	489,298	350,549	408,334	423,500	236,263
Hams and shoulders	do.	166,813	203,701	282,208	206,656	419,572	667,240	275,456	172,012	271,642	319,269	381,564	292,214
Pickled pork	do.	48,275	45,656	63,461	46,993	33,222	31,504	41,643	33,286	33,510	40,934	37,469	26,726
Canned pork	do.	4,227	4,645	9,611	5,195	5,273	5,273	3,262	1,119	2,263	2,699	2,691	4,186
Fresh pork	do.	2,024	3,908	63,005	50,435	21,390	19,645	27,225	57,075	25,911	43,772	49,113	27,603
Total pork	do.	403,813	604,628	998,094	1,037,133	1,294,673	1,961,909	1,151,253	752,790	683,875	815,008	894,337	586,992
Mutton and lamb.	do.	3,539	3,877	5,553	3,196	2,098	2,174	3,958	7,255	2,502	1,769	1,633	1,460

Lard and neutral lard	do.	501, 553	462, 346	396, 765	742, 167	610, 427	768, 702	881, 952	979, 136	1, 039, 137	813, 156
Oleo oil	do.	80, 482	67, 110	56, 603	59, 292	74, 529	106, 415	117, 174	104, 956	92, 965	105, 145
Tallow	do.	20, 240	16, 289	5, 015	16, 172	32, 937	16, 844	27, 658	25, 665	37, 372	28, 776
Other meat products ¹	do.	115, 019	104, 617	69, 834	190, 634	134, 750	107, 473	102, 312	63, 589	64, 446	75, 286
Total meat and meat products	do.	1, 257, 249	2, 008, 771	2, 346, 834	3, 458, 078	2, 224, 932	1, 814, 638	1, 799, 989	2, 020, 637	2, 156, 103	1, 638, 201
Apples ²	Barrel	1, 551	1, 466	635	1, 576	1, 051	2, 665	1, 094	1, 756	4, 098	3, 221
Cotton	500-pound bale	8, 840	6, 168	4, 641	5, 526	7, 087	5, 623	6, 718	5, 253	5, 899	8, 439
Tobacco, leaf (including stems and trimmings)	Pound	392, 183	443, 293	289, 171	629, 288	648, 038	506, 526	463, 359	454, 364	597, 630	430, 702
Total agricultural exports, including forest products	Dollar	1, 143, 642	1, 586, 227	2, 037, 172	3, 693, 193	4, 051, 560	2, 749, 518	2, 009, 981	1, 929, 150	2, 029, 897	2, 436, 805
Total agricultural exports, excluding forest products	do.	1, 038, 041	1, 518, 071	1, 968, 253	3, 579, 918	3, 861, 511	2, 607, 642	1, 915, 866	1, 799, 168	1, 867, 098	2, 280, 165
Index of volume of exports, excluding forest products	Index No.	100	118	101	145	134	127	137	112	104	126

¹ 5-year average for lard and 4-year average for neutral lard; neutral lard included with "oleo oil" in 1910.

² Includes neutral lard for 1910.

³ "Other meat products" include the following items: Canned sausage, other sausage, sausage casings, lard compounds, lard oil, oleomargarine, oleo and lard stearin, grease stearin, oleic acid or red oil, stearic acid, and other fatty acids.

⁴ Includes boxed apples, boxes reduced to barrels on the basis of 3 boxes to the barrel.

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REPORT OF THE SOLICITOR

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,

Washington, D. C., October 14, 1925.

SIR: I submit herewith report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1925.

Respectfully,

R. W. WILLIAMS,
Solicitor.

HON. WILLIAM M. JARDINE.
Secretary of Agriculture.

It is gratifying to be able to report that the office force was reduced by the elimination of three positions during the fiscal year—one attorney, one stenographer, and one messenger.

Congress at its last session added two statutes to the long list of laws committed to the Secretary of Agriculture for administration, namely, the so-called Purnell Act providing additional appropriations for the agricultural experiment stations in the various States for the conduct of investigations and experiments bearing on the production, manufacture, preparation, use, distribution and marketing of agricultural products, including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life, and the Alaska game law, embodying a comprehensive scheme for the conservation of wild animals and birds in Alaska, in which scheme the Secretary of Agriculture occupies an important position.

Having brought to completion and effected the distribution of the compilation of Laws Applicable to the Department of Agriculture, which was in course of preparation during the last fiscal year, work is now under way on a compilation of the decisions of the courts bearing directly upon the statutes administered by the Secretary of Agriculture. The need for such a compilation, not only for the use of the Department of Agriculture but also for the use of United States attorneys in handling the business of the department, is constantly felt.

At the request of the Chief of the Biological Survey, the solicitor went to Madison in April for conference with the Governor of Wisconsin on proposed legislation in that State required by the upper Mississippi River wild life and fish refuge act to enable the United States to acquire lands in that State for the purposes of this law. The legislature subsequently enacted a statute for the purpose.

At the request of the Bureau of Agricultural Economics compilations were prepared of the laws of the several States relating to cotton tare and cotton gins and gin regulations.

At the request of the Bureau of Chemistry one of the attorneys in the office was detailed to accompany the bureau's experts on an investigation in Alaska of the salmon-packing industry.

Much consideration was given to the acute situation of the deer on the Grand Canyon National Game preserve in the Kaibab National Forest and a memorandum was prepared for the information of the Attorney General in anticipation of forcible action by the State of Arizona to interfere with the department's plan to relieve that situation.

The following is a statistical summary of the work of the office during the year:

Four hundred and fifty-two formal written opinions were rendered to the administrative officials of the department. No record was preserved of the advice given these officials in daily informal consultations, nor opinions expressed in brief pencil notations on papers sent to the office for consideration.

Thirteen hundred and twenty-five notices of judgments were prepared for

publication pursuant to authority contained in section 4 of the food and drugs act and section 4 of the insecticide act.

In addition to the criminal prosecutions hereinafter tabulated, 886 decrees of condemnation and forfeiture were entered under the food and drugs act, and 11 under the insecticide act.

There were reported to the Attorney General 2,964 violations of statutes entrusted to the department for enforcement.

The following table shows the several statutes under which these violations were reported and the amounts of fines and recoveries in cases settled with and without contest:

Cases reported, fines imposed, and judgments recovered

Laws involved	Number of cases	Fines and recoveries
National forest laws.....	309	\$66,085.16
Food and drugs act.....	1,210	29,558.50
28-hour law.....	539	53,825.00
Meat-inspection act.....	37	4,465.00
Animal quarantine acts.....	52	6,510.00
Lacey act.....	-----	25.00
Migratory bird treaty act.....	638	11,106.55
National forest game preserve act.....	9	365.00
Insecticide act.....	90	3,332.00
Plant quarantine act.....	35	570.00
Section 84 penal code.....	20	116.00
Virus serum toxin act.....	2	60.00
United States warehouse act.....	2	100.00
United States grain standards act.....	3	-----
Miscellaneous.....	18	686.24
Total.....	2,964	176,804.45

Contracts and leases prepared or examined

Bureau, division, or office	Contracts	Leases	Total
Forest Service.....	1,651	7	1,658
Bureau of Animal Industry.....	2	24	26
Biological Survey.....	-----	2	2
Bureau of Chemistry.....	2	4	6
Chief clerk.....	3	4	7
Bureau of Entomology.....	2	37	39
Bureau of Agricultural Economics.....	5	52	57
Federal Horticultural Board.....	3	5	8
Insecticide and Fungicide Board.....	4	2	6
Mechanical Shops.....	1	-----	1
Packers and Stockyards Administration.....	-----	18	18
Bureau of Plant Industry.....	14	24	38
Bureau of Public Roads.....	29	14	43
Weather Bureau.....	35	32	67
Grain Futures Administration.....	-----	3	3
Solicitor's Office.....	-----	1	1
Fixed Nitrogen Research Laboratory.....	1	-----	1
Total.....	1,752	229	1,981

During the year 33 bonds, 305 renewals, and 8 terminations of leases

and contracts were prepared. In addition to the examination of the above-tabulated contracts for sufficiency as to execution, there were also examined 1,179 Federal highway project contracts and 624 modifications of such contracts.

Thirty-one claims of balances due estates of deceased employees were examined. Necessary papers were prepared for their payment and advice furnished administrative officers in connection therewith.

Aid was given the Interdepartmental Board of Contracts and Adjustments in the preparation of standard forms of construction contracts and of contracts for the purchase of supplies, and in the preparation of a tentative bill for the codification of the laws relating to Government contracts.

Agreements and forms of liens were prepared and advice given in the matter of seed loans made by the department in New Mexico under the joint resolution of April 26, 1924 (43 Stat. 110). Advice was also given in connection with the collection of loans made by the department under the seed loan acts of 1921 and 1922.

Assistance was given the committee on simplified business methods and office procedure in drafting orders and memoranda of the Secretary for the general administration of the department and to the Forest Service in connection with the disposition of claims for reimbursement for property lost, damaged, or destroyed while being used for official work in the national forests.

Attorneys of this office appeared at court hearings on behalf of several of the employees of the department who were arrested during the year for alleged violations of the District of Columbia traffic regulations.

Twelve claims growing out of damages to privately owned property resulting from the negligence of employees of the department while engaged in the performance of their official duties were considered under the act of December 28, 1922 (42 Stat. 1066).

Six claims of the department were prepared and filed in bankruptcy proceedings pending in several of the United States district courts.

Hearings and conferences relating to the varied activities of the department were participated in by members of the office. Among the more important of such conferences were one between officials of the Bureau of Agricultural Economics and representatives of the cotton growers and manufacturers on proposed changes in the cotton stand-

ards representing length of staple; one with representatives of the Federal Trade Commission on the legal phases of the proceedings brought by the commission against the Minnesota Chamber of Commerce on account of its refusal to admit to its membership a cooperative exchange, an association of wheat growers selling their grain on a cooperative basis; and one with the committee of the American Drug Manufacturing Association and the American Pharmaceutical Association on the methods of the preparation of various drug tablets so that they will meet the requirements of the provisions of the food and drugs act. Conferences were also attended on matters touching the administration of the national forests laws, the plant quarantine, meat inspection, cotton standards, and tea importation acts, and the promulgation of regulations under the Alaska game and animal quarantine laws. Daily conferences were held with attorneys and others interested in seizure and criminal cases pending in the Federal courts under the food and drugs act, and numerous conferences were also held with lawyers and others relative to litigation and other matters arising in connection with the various other regulatory laws of the department.

Regulations, orders, proclamations, forms, specifications, and schedules required in the enforcement of the various statutes committed to the department for administration were prepared, or assistance given in their preparation. Among the more important of these were regulations for the enforcement of the plant quarantine, insecticide and fungicide, tea importation, and Alaska game acts; regulations governing the recognition of breeds of purebred animals, the sanitary handling and control of hides, glue stock, and other animal products offered for entry into the United States, and the storing of products under the United States warehouse act. Orders or amendments to the regulations dealing with meat inspection, animal and plant quarantines, foot-and-mouth disease, interstate movement of livestock, animal-tuberculosis eradication, revocation or suspension of licenses of grain inspectors, and fiscal administration of the department, were also prepared, reviewed, or revised.

Assistance was rendered in the preparation of the department's reports as to the legal sufficiency of various bills referred to it by committees of Congress. Included among the bills so reported upon were H. R. 8374, providing for the amendment of section 10 of the plant quarantine act, so as to

authorize search of persons and vehicles bringing into the United States, or carrying interstate, articles prohibited by any quarantine promulgated under that act; H. R. 9629 providing for the reorganization and more effective coordination of the executive branch of the Government, creating the Department of Education and Relief; H. R. 12178 and 12179, each designed to create a right of action against the United States for personal injuries or death resulting from the negligence of the officers, agents, or employees of the United States, and to provide a tribunal for a hearing and adjustment of such cases; S. 3107, amending the cotton futures act by providing that all commodity exchanges make their market quotations available to everyone on equal terms; S. 4190, authorizing the issuance of patents to the State of South Dakota for park purposes of certain lands within the Custer State Park; H. R. 129, authorizing entry of the public lands by school districts for school-house site and ground; H. R. 8207, extending the provisions of the homestead laws so as to allow certain credit, in lieu of permanent improvements, for the period of enlistment to soldiers, nurses, officers, and others of the Army and Navy; and H. R. 11723, designed to protect the public against fraud by prohibiting the sale in interstate or foreign commerce of misbranded articles and for other purposes. Assistance was also given in the preparation of an amendment to section 7 of the Weeks forestry law, authorizing the Secretary of Agriculture, with approval of the National Forest Reservation Commission, to exchange lands of equal value within national forests created under that act, for other lands within or adjacent to those forests and chiefly valuable for the purposes contemplated by that law; of a bill authorizing the transfer of the United States Weather Bureau site and buildings at East Lansing, Mich., to the State of Michigan, in exchange for another site; of a joint resolution authorizing the Secretary of Agriculture to cooperate with Territories and other possessions of the United States under the provisions of certain sections of the Clarke-McNary Forestry Act; and of a joint resolution amending section 10 of the upper Mississippi River wild life and fish refuge act so as to simplify the terms of acquisition of areas for the purposes of this act.

Papers of various kinds, including statements of issues, briefs, and memoranda on legal matters, were prepared at the request of officials of this department for submission to the Attorney

General, the Secretary of the Interior, the Comptroller General, and officials of other departments. There were also many service and regulatory announcements, circulars, and bulletins, referred to this office for consideration from a legal aspect.

In many of the cases referred to the Attorney General for prosecution, briefs and memoranda on legal questions involved were prepared and furnished, and, in addition, assistance was given the United States attorneys in the trials of some of them. Among the more important cases in which this office assisted either in the preparation of briefs, or in the trials, or both, were: *United States v. D. J. Alford*, a criminal prosecution based on a fire trespass on the Florida National Forest, and *United States v. Broxon*, a prosecution for the cutting of timber from the same forest in violation of sections 49 and 50 of the Federal Penal Code; *United States v. Frank S. Gresham*, a criminal prosecution under the Federal warehouse act; *United States v. 109 Cases and 134 Cases of Canned Salmon*; *United States v. 2,205 Cases of Canned Salmon*; *United States v. 10 1-lb. Packages of Coal-Tar Colors*; *United States v. 29 Barrels of Cherries*; *United States v. 300 Sacks of Oats*; *United States v. Crab Orchard Mineral Water*; *United States v. Jopp's Drug Company*; *United States v. J. R. Strassenburgh Company*; *United States v. 1,000 Cases Canned Salmon*; *United States v. 18 Cases Tuna Fish*; *Goodwin et al. v. United States (295 Fed. 856)*; *United States v. Belcan Brand Canned Salmon*; *United States v. Macon Creamery Company*; *United States v. 5½ Gallons Fruit Grape Extract*; *United States v. 32 Cases Prepared Mustard*; and *United States v. Iola Creamery Co.*, all involving violations of the food and drugs act; *United States v. F. G. Ringle*; *United States v. W. A. McFarland*; *United States v. W. M. Gordin*; *United States v. Kraus and Apfelbaum*; and *United States v. John E. McMurtry*, all involving recovery of profits made by licensed wool dealers in excess of the profits fixed by the War Industries Board; and *Conover and Gibbs v. Wohl*, interference cases pending in the United States Patent Office for the determination of priority of invention involved in the subject matters covered by two letters patent issued jointly to Conover and Gibbs on processes for the manufacture of anthraquinone and phthalicanhydride, respectively, and the applications of Wohl for letters patent on the same processes.

Indictments and informations in practically all of the criminal cases arising

under the regulatory laws of the department were prepared by this office and submitted to the various United States attorneys. Complaints in 28-hour law violations and, when practicable, libels in food and drugs cases were prepared and furnished United States attorneys. Preparation of these pleadings in this office not only substantially aided the United States attorneys in handling the cases but also served materially to expedite their consideration by the courts.

THE NATIONAL FORESTS

There were handled before the Department of the Interior 339 claims for lands within the national forests, based upon the various land laws of the United States. Of 61 decisions by that department 46 were favorable to the Government and 15 unfavorable. Attorneys of this office participated in the trials of 74 court cases and represented the Government before the United States local land offices in 35 cases. Numerous written opinions relating to the administration of the national forests were submitted and there were prepared or passed upon for legal sufficiency over 1,600 legal papers of various kinds.

Work for the Forest Service during the fiscal year, other than under the Weeks forestry law, included handling the following cases and other business:

Claims to lands pending during year.....	339
Hearings attended.....	35
Briefs prepared and filed.....	43
General litigation and settlement.....	56
Contracts, leases, bonds, etc.....	1,404
Bills, complaints, informations, protests, etc.	170
Court appearances.....	74
Written opinions.....	417
Stipulations.....	66
Subpoenas.....	12
Trespasses:	
Grazing.....	283
Timber.....	61
Fire ¹	155
Property.....	12
Occupancy.....	21

Trespass cases on the national forests in which damages and fines were recovered

Character of trespass	Number	Damages	Fines
Grazing.....	146	\$35,045.89	\$170.00
Timber.....	31	9,302.95	125.00
Fire.....	89	17,734.61	1,964.10
Property.....	5	45.00	30.00
Occupancy.....	2	136.80	-----
Total.....	273	62,265.25	2,289.10

^a Cases prosecuted in State courts not included.

¹ Cases prosecuted in State courts not included.

DECISIONS OF INTEREST

By decisions of April 6 and June 12, 1925, in the case of *United States v. Helen L. Givens*, the Interior Department sustained the contentions of this department, thereby bringing to an end a controversy which has lasted for seven years. The case involved approximately 80 acres of land in California within the limits of two railroad grants under the acts of Congress of 1866 and 1871 and withdrawn in 1892 as a part of the Angeles National Forest. Both of the railroad grants failed, but prior to a determination of this fact certain lands including those here involved were sold by one of the railroad companies to innocent purchasers. For the relief of these purchasers, Congress passed the act of March 3, 1887 (24 Stat. 556), which, by section 5, provided for the acquisition by them of the lands purchased from the United States. It was admitted by the Government that the right of Brunk and Painter (predecessors in interest of Givens) to purchase the lands in question was superior to the forest withdrawal, but contended that the right which was determined in 1898 was barred by laches, the application to purchase not having been filed with the Land Department until 1917. The protest filed in behalf of the Forest Service was dismissed by the General Land Office and the dismissal affirmed by the Secretary of the Interior in 1922. Upon motion for rehearing, this department was successful in having all former decisions recalled and the case returned to the field in order that a hearing might be held on the protest. The resulting decisions of the register and receiver of the local land office, the Commissioner of the General Land Office, and the First Assistant Secretary of the Interior were favorable to the Government. The act of Congress involved, while conferring upon described persons the privilege to purchase certain lands, failed to prescribe the period within which the privilege should be exercised, and it was contended by this department that a reasonable time should be presumed and that the application of Givens filed in 1917 was not presented within a reasonable time after the right to purchase had been judicially determined in 1898. The application to purchase occasioned considerable concern in the Forest Service and among individuals living in the vicinity of the land, as a ranger station had been erected and about 30 permittees had built summer homes and a clubhouse on the land covered by the application.

The land and improvements were valued at over \$100,000 by the General Land Office. Givens's claim was purchased from Painter for \$50. The conclusion reached in the case resulted in saving to the Government a valuable tract of land in administrative use and prevented what is considered to have been an effort on the part of the applicant, or others acting through her, to take an inequitable and unfair advantage of those who had by considerable labor and large expenditures of money improved the lands.

In the case of Forest Ranger Charles E. Long, it was held by the United States District Court for the Northern District of West Virginia that the pistol "toting" law of that State could not legally be invoked against a representative of the United States who is engaged in duties pertaining to the Federal Government, the performance of which necessitates the carrying of firearms. Long had been indicted, arrested, and convicted in Tucker County, W. Va., for carrying a pistol contrary to the State law, and sentenced by the circuit court of that county to six months in jail and to pay a fine of \$100. He was discharged from custody by the Federal Court in habeas corpus proceedings.

In *People v. McPherson* (232 Pac. 675) the Supreme Court of Colorado held unconstitutional a statute of that State requiring a license of nonresident owners bringing cattle within the State to graze upon the public lands. The court held the statute void as an attempt to regulate the use of public lands of the United States and also because it discriminated between citizens of that State and those of other States, contrary to the Constitution.

During the past year a number of persons have sought to acquire lands in the national forests under the act of August 4, 1892 (27 Stat. 348), which renders lands chiefly valuable for the building stone thereon subject to the placer mining laws which are applicable to lands withdrawn for forest purposes. In the case of *United States v. Meredith*, decided by the First Assistant Secretary of the Interior on June 12, 1925, the defendants applied for lands within the Cleveland National Forest, Calif., under the mining laws, alleging that they were chiefly valuable for building stone. The evidence disclosed, however, that the tract was actually used as a commercial site, the claimants maintaining thereon an oil and gas filling station. It was shown that the stone in the land was of a

low grade prevalent in the community, which could be used for rough work such as road building. The Land Department held that the act applies only to deposits of stone of special or peculiar value for structural work, such as the erection of houses, office buildings, and such other recognized commercial uses as command and will secure the profitable extraction and marketing of the product, and has no application to the vast deposits of low-grade rock in the public domain, which possess no special or peculiar value for structural purposes and are useful only for rough work in the immediate vicinity.

WEEKS FORESTRY LAW (36 Stat. 961)

Titles to various tracts of land, comprising in all 289,874 acres, acquired in Alabama, Arkansas, Georgia, New Hampshire, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia, under the Weeks forestry law, were examined and titles to approximately 25,000 acres, in addition, were in process of examination. Defects in titles to various parcels of land aggregating 106,727 acres

were removed by appropriate judicial proceedings, resulting in the acquisition of the lands and the vesting of safe title thereto in the United States.

The National Forest Reservation Commission held three meetings and authorized the Secretary of Agriculture to acquire approximately 247,225 acres of land located in several States, which acreage was offered for sale to the United States by 250 different owners. These authorizations included purchases that were to be paid for from the appropriation for the fiscal year 1926. While these authorizations did not permit the acquisition of the lands until the appropriation for the ensuing fiscal year was available, nevertheless it was thought that it would materially expedite the work involved in their acquisition if the title examinations and surveying were begun within the present fiscal year, and that such action would result in benefit both to the vendors and the Government, as it would advance substantially the date on which final settlement of the purchases could be completed.

Two hundred and fifty-four agreements of purchase were prepared, covering an area in excess of 240,000 acres.

Summary of the operations, in terms of acres, under the Weeks Forestry law, during the fiscal year

State	Acreage acquired, 1925	Acreage in condemnation	Titles examined, acquisition pending	Acreage to be examined and acquired	Purchases authorized, 1925	Purchases authorized previous to June 30, 1924, but not acquired
Alabama.....	4,419		2,591	689	5,846	1,853
Arkansas.....	1,646	1,114	10,239	5,891	17,027	1,863
Georgia.....	699			39,764	40,070	393
Maine.....						
New Hampshire.....	407	1,685	14	21,587	21,619	2,074
North Carolina.....	3,960	119	18,212	6,115	24,435	3,971
Pennsylvania.....	48,274	5,384	34,397	29,089	30,023	87,121
South Carolina.....		610	16,686	5,467	21,967	796
Tennessee.....	17,684	3,989	46,944	16,054	66,050	18,621
Virginia.....	7,849	1,530	51,797	20,415	17,110	177,669
West Virginia.....	21,789	3,423	2,267	2,796	3,078	14,009
Total.....	106,727	17,854	183,147	147,867	247,225	208,370

¹ Includes 10,186 acres in West Virginia.

THE FOOD AND DRUGS ACT (34 Stat. 768)

One thousand two hundred and ten cases under the food and drugs act were transmitted to the Attorney General during the fiscal year—270 for criminal prosecution and 940 for seizures. The 270 criminal cases embraced 773 alleged violations of the act.

One thousand five hundred and forty-four seizure cases were pending during the year. Included in this number were 604 cases that were pending at the close of the last fiscal year. Nine hundred and sixty-nine of these cases were terminated.

Of the 269 criminal cases that were pending at the close of the fiscal year 1924 and the 270 cases that were re-

ported during the present fiscal year, 374 were terminated.

The total number of cases terminated during the year, both seizure and criminal, was 1,343.

In 313 of the 374 criminal cases terminated fines were imposed or collateral forfeited. Of these 313 cases, 285 were terminated on pleas of guilty, while 27 were terminated on pleas of nolo contendere. One case was terminated on a plea of nolo contendere and no fine was imposed. Of the remaining 61 criminal cases closed, 2 were dismissed after demurrers to the informations had been sustained, and 44 were nolle prossed or discontinued. Fifteen criminal cases were contested, 2 of which resulted in directed verdicts for the defendant, 9 in acquittal, and 4 in conviction. In the 4 convictions, fines totaling \$2,990 were assessed.

Fines imposed in criminal cases (exclusive of costs, which were generally assessed)

Number of cases	Amount of fine	Total
1	\$1,300	\$1,300
1	1,000	1,000
1	750	750
1	600	600
3	500	1,500
1	450	450
1	400	400
1	370	370
1	330	330
2	300	600
1	303	303
1	275	275
7	250	1,750
1	220	220
17	200	3,400
1	165	165
13	150	1,950
1	145	145
1	140	140
2	125	250
2	120	240
69	100	6,900
9	75	675
1	70	70
1	60	60
80	50	4,000
3	40	120
4	30	120
36	25	900
11	20	220
3	15	45
1	12.50	12.50
28	10	280
3	5	15
3	1	3
1	(¹)	-----
313	-----	29,558.50

¹ No fine.

Of the 969 seizure cases terminated, default decrees of condemnation, forfeiture, and destruction of the product seized were entered in 326;

in 560 consent decrees of condemnation and forfeiture were entered and the product released under bond for relabeling or reconditioning; 11 were contested, all of which resulted in verdicts for the Government after trial, and in 72 the libels were either dismissed or the product disposed of before actual seizure could be consummated.

At the close of the year 767 cases were pending, of which 192 were criminal prosecutions and 575 were seizures.

One thousand two hundred and fifty notices of judgments were prepared and published. Trial briefs were prepared for the use of United States Attorneys in 7 contested cases, and 8 memorandum briefs were prepared for their use in the argument of pending motions or demurrers. Three cases were tried by members of the office at the request of United States attorneys, and in six cases members of the office assisted them in the preparation and trial of cases.

COURT DECISIONS OF INTEREST

Goodman et al. v. United States, F. and D. No. 15395 (295 Fed. 856), appellant contended that the food and drugs act had conferred admiralty jurisdiction and that the proceedings therein had not conformed to the admiralty practice. The court held that the statute did not confer or purport to confer admiralty jurisdiction upon United States district courts in food and drug cases, but that the provision that the libel be filed and that the proceeding conform as near as may be to the proceedings in admiralty related only to procedure and not to jurisdiction. It was also held that the libel which set forth a list of ailments for which the water purported to be beneficial and denied that the water was capable of producing the therapeutic effect claimed, does not fail to state a case under the statute and was not subject to demurrer or motion to quash. It was held that if defendant needed a better specification of the particulars upon which the Government would rely a motion for a bill of particulars would have been the proper relief. Another issue in the case involved the question as to whether concentrated mineral water was a food or a drug. It was decided that the water in this case was a drug, inasmuch as the concentration had rendered the water unfit for use as a beverage and had brought the article fairly within the meaning of the word

"drug" as used in the statute. It was further held that it was not necessary for an expert witness to have had actual experience with, or to have actually observed, the effect of a particular medical compound if the witness has knowledge of the constituent elements and of their efficacy or lack of efficacy as curative agents, either separately or in combination, in the treatment of the diseases specified on the label. The weight of his testimony thereon is a matter to be considered by the jury.

In *United States v. 109 Cases and 134 Cases of Salmon, F. and D. No. 17469, N. J. 12956*, the court charged the jury that where the evidence discloses uncontroverted testimony as to the presence of putrid and tainted fish it could take into consideration the question of whether ordinary care had been used in the packing of the fish. The jury was also charged that the act required nothing impossible of the shipper and that consideration should be given to the conflicting testimony as to the possibility of entirely eliminating decomposed fish during packing. The final test was laid down for the jury to determine from all the evidence as to whether the entire shipment of canned salmon contained decomposed and putrid animal matter to the extent that it should be condemned. The jury returned a verdict for the Government.

In *United States v. McIlvaine Brothers, F. and D. No. 18361, N. J. No. 12919*, a criminal action was brought charging adulteration and misbranding of powdered colocynth apple, a drug, in that its strength, quality, and purity fell below the standard for the article as laid down in the pharmacopœia. In an opinion rendered by the trial judge it was held that since the labeling of the article did not sufficiently apprise the purchaser of the inferiority of the article, that was a violation of the act and that a branding which is misleading because of its ambiguity is as much within the inhibition of the statute as if it were misleading in statement.

In *United States v. 100 Cases et al. of Salmon, F. and D. Nos. 17265-6, 17270-1, 17287, 17375, and 17387, N. J. No. 13605*, the court charged the jury that the word "article" as used in the food and drugs act does not refer to the single separate can, or to the single or separate case of salmon in each shipment, but refers to each lot or shipment under seizure. Upon a request by claimant to charge that the fact that cooked and sterilized rotten fish was not deleterious to health should be considered in arriving at a verdict of adulteration, the court said that the statute

was clear of ambiguity and the words were to be taken in the ordinary and everyday meaning, and that where decomposed food is barred from interstate commerce it would be improper to take into consideration whether the salmon would be unfit to eat or hurtful to health. To warrant condemnation, the jury were charged that they must find that decomposition existed and that it extended to a substantial degree throughout the whole shipment.

In *United States v. 10 One Pound Packages of Colors, F. and D. No. 19043*, the court charged the jury, as to misbranding of food colors, that if the statements on the packages were false and misleading so as to mislead the purchaser into thinking he was getting something which he did not get, then there should be a finding for the Government. The jury were instructed that the question of intention on the part of the seller should not be taken into consideration but that the controlling consideration was the effect of the labeling on the minds of persons purchasing the article.

United States v. South Hero Creamery Association, F. and D. No. 19269, is of special importance in that it was the first case tried before a jury since the butter standard act (42 Stat. 1500) became effective. Previous to the enactment of this law it was necessary for the Government to establish by trade testimony in each case what was the normal or usual butterfat content of butter. Under the terms of the act butter is defined as containing 80 per cent butterfat. Thus it is now only necessary to show that the butterfat content falls below that percentage in order to establish adulteration under the food and drugs act. The prosecution of the South Hero Creamery Association was based on the shipment in interstate commerce of butter which was alleged to be adulterated in that it was deficient in butterfat and misbranded in that the tubs containing it failed to bear plain and conspicuous statements of the quantity of contents. The court instructed the jury that it was an offense to ship in interstate commerce any butter that contains less than 80 per cent butterfat and that it was equally an offense to ship butter in tubs without marking the weight on the tubs. The jury returned a verdict of guilty on the adulteration charge and a verdict of not guilty on the misbranding count.

United States v. 18 Cases of Tuna Fish, F. and D. No. 19958-9, was a seizure proceeding in which the question was raised as to the right to issue monition and attachment as of course

on libels of information which are unsupported by oath or affirmation. In ruling that such writs could issue without verification, the court in analyzing the procedure distinguished attachment for seizure of property from search warrants and ordinary warrants for the arrest of persons for crime, holding that the fourth amendment of the Constitution was not intended to apply to attachments for the seizure of property under section 10 of the food and drugs act, but applied to warrants for the arrest of persons charged with crime or to warrants which direct both search and seizure. It was held that since the delay which would arise by requiring verification by affidavits might easily be fatal to the carrying out of the purposes of the act, it was within the discretion of the court, where the procedure under the act prescribed only that the proceedings shall conform as near as may be to proceedings in admiralty, to adopt a ruling which would best carry out the purposes of the act.

THE INSECTICIDE ACT OF 1910 (36 Stat. 331)

Ninety cases were reported to the Attorney General, in 79 of which, involving 99 violations, criminal proceedings, and in 11, seizures, were recommended. At the close of the previous fiscal year 87 cases were pending, 80 of which were criminal prosecutions and 7 seizure proceedings.

Forty-seven cases pending at the close of the previous fiscal year and 45 reported this year, in all 92, were terminated. Of the cases terminated, 81 were criminal and 11 seizure. Of the 81 criminal cases, fines were imposed in 72 and 9 were dropped or dismissed. Pleas of guilty were entered in 60, pleas of nolo contendere in 10, the defendant in 1 was declared in default, and collateral was declared forfeited in 1.

Fines in criminal cases in which convictions were obtained

Number of cases	Amount of fine	Total
2	\$1	\$2
1	5	5
11	10	110
10	20	200
24	25	600
1	40	40
10	50	500
1	75	75
6	100	600
4	150	600
2	300	600
72	-----	3,332

Court costs were assessed in the greater number of cases in which convictions were obtained. Decrees of condemnation and forfeiture were entered in 11 cases, in all of which the goods were destroyed. Seventy-five notices of judgments were prepared and published, and a number of memorandum briefs were prepared for the use of United States attorneys in the trial of cases.

MEAT-INSPECTION ACT (34 Stat. 1260)

Thirty-seven cases were reported to the Attorney General for prosecution under the meat-inspection act. Of these, 18 were terminated by fines, as follows: 1, \$700; 1, \$400; 1, \$150; 3, \$100 each; 8, \$50 each; and 4, \$25 each. Four cases were terminated, 1 by dismissal and three by refusal of the grand jury to indict.

Of the cases pending at the close of the preceding fiscal year, 12 were terminated by fines, as follows: 1, \$1,900; 1, \$75; 1, \$55; 7, \$50 each; 1, \$25; and 1, \$10. One case was nolle-prossed, 1 was dismissed, and the prosecution of 7 was barred by the statute of limitations. Fines aggregating \$4,465 were imposed in the 30 cases, as follows:

Fines imposed in meat-inspection cases

Number of cases	Fines	Total
1	\$1,900	\$1,900
1	700	700
1	400	400
1	150	150
3	100	300
1	75	75
1	55	55
15	50	750
5	25	125
1	10	10
30	-----	4,465

VIRUS-SERUM-TOXIN ACT (37 Stat. 833)

Two cases were reported to the Attorney General under the virus-serum-toxin act and both are pending. The two cases pending at the close of the preceding fiscal year were both terminated, one by a fine of \$20 and costs and the other by a fine of \$40.

PLANT QUARANTINE ACT (37 Stat. 315)

Thirty-five cases were reported to the Attorney General for prosecution under the plant quarantine act of August 20, 1912 (37 Stat. 315). Of these, 10 were closed by the imposition

of fines and 1 by a jail sentence. At the close of the fiscal year 1924, there were 28 cases pending, 15 of which were closed during this year by the imposition of fines and 3 by dismissal of the informations. In addition, fines were imposed in 4 cases instituted by United States attorneys on their own initiative.

Fines imposed in plant-quarantine cases

Number of cases	Amount of fine	Total
4	\$5	\$20
12	10	120
2	15	30
8	25	200
2	50	100
1	100	100
29	-----	570

There were 34 cases pending at the close of the year, 10 of which were pending at the beginning of the year and 24 submitted during the year.

Seven written opinions were rendered on questions raised under this act and many informal opinions were given.

There were examined for legal sufficiency and accuracy 1 notice of quarantine proposed for promulgation under the act, 8 amendments to rules and regulations to be promulgated under existing quarantines or orders, and 1 restrictive order, involving the entry of cotton from certain portions of Mexico.

FEDERAL HIGHWAY ACT (42 Stat. 212)

Project statements for 729 projects approved by the department under the Federal highway act were first reviewed to determine whether they were eligible for Federal aid. These projects involved a total estimated expenditure of \$366,404,405.70 and 15,603.4 miles of road. The amount of Federal aid which will be allocated for these projects has not yet been determined, as under the revised project statement form now being used a project covers the whole route between given control points, and the Federal aid is only requested and allocated as each section of the project is reached for actual construction.

Project agreements and certificates of approval of plans, specifications, and estimates, prepared by the Bureau of Public Roads, for 1,025 projects were reviewed as to their form and sufficiency of their execution by the State highway departments and were submitted to the Secretary and executed by him, involving a total estimated ex-

penditure of \$189,118,419.34, Federal aid aggregating \$78,659,240.59, and 8,173.5 miles of road. Drafts of 624 modifications of project agreements and certificates, prepared by the Bureau of Public Roads for execution by the State highway departments and the Secretary, were similarly reviewed.

There were also reviewed as to form, substance, and sufficiency of execution 90 original agreements, with their accompanying surety bonds, involving the construction of roads within or partly within the national forests. There were similarly reviewed 64 co-operative agreements between the department and cooperating States or other agencies within the several States for constructing road projects within or partly within the national forests.

Eight written and numerous informal opinions were rendered the Chief of the Bureau of Public Roads on questions arising in the administration of the act.

OPINION OF INTEREST

An important decision was rendered by the United States District Court for the District of Indiana, in the equity case of *United States v. J. P. Babcock et al.*, involving the right of a contractor, under a contract authorized by the superior court of Allen County, Ind., to construct a drainage ditch across the Lincoln Highway (a road constructed with Federal aid), without making provision for the permanent replacement of the highway in as good a condition as it was before being disturbed by the ditch construction. The United States asked for a permanent injunction restraining the defendants from entering upon and cutting through the Lincoln Highway between the city of Fort Wayne, Ind., and the Ohio State line. The decision recites that the highway proposed to be cut through is an important artery of interstate commerce used by citizens of the United States for travel between Indiana and Ohio and between the District of Columbia and the city of San Francisco; that the United States mail is carried over it daily; that the construction proposed will cut an open ditch through this highway and leave it there as a permanent obstruction; that State courts and officials admit that they have no power to prevent this result; and that no one is willing to assume responsibility of replacing the destroyed highway pavement. The court said that there is no doubt in its mind as to the authority of the National Government to remove obstructions to highways used in interstate

commerce, whether the highways be artificial or natural, and if the Government has the power to remove an obstruction, it has the power to prevent such obstruction in the first instance. The court cited the case *In re Debs*, 158 U. S. 564, as showing that the United States Supreme Court had announced this principle with respect to such artificial highways as railroads, and then held that this principle is likewise applicable to such an artificial interstate highway as the Lincoln Highway, upon the construction of which the Government has spent many thousands of dollars. The permanent injunction prayed for was granted.

ACTS RELATING TO THE INTERSTATE MOVEMENT OF LIVESTOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVESTOCK, AND PROHIBITING THE IMPORTATION OF DISEASED LIVESTOCK (23 Stat. 31; 26 Stat. 414; 32 Stat. 791; 33 Stat. 1264)

Five cases involving violations of the act of May 29, 1884 (23 Stat. 31), were reported to the Attorney General for prosecution, of which 1 was terminated by a fine of \$100 and costs. Of the cases pending at the close of the preceding fiscal year, 1 was terminated by a fine of \$100 and costs, 1 by a fine of \$100, 1 by a fine of \$50, 1 by a fine of \$25; 1 case was nolle-prossed, and 1 dismissed. There were 7 cases pending at the close of the year.

Thirty-one cases were reported to the Attorney General for prosecution under the act of February 2, 1903 (32 Stat. 791), of which 1 was terminated by a fine of \$300 and costs, 1 by a fine of \$100 and costs, 8 by fines of \$100 each, and 1 by a fine of \$25. Two cases were nolle-prossed. Of the cases pending at the close of the preceding fiscal year, 2 were terminated by fines of \$300 and costs each, 1 by a fine of \$200 and costs, 6 by fines of \$100 and costs each, 8 by fines of \$100 each, 1 by a fine of \$50 and costs, 1 by a fine of \$25, 1 by a fine of \$10 and costs, and 1 by a fine of \$1. Four cases were nolle-prossed, 2 were barred by the statute of limitations, 5 were dismissed, and a report of "no true bill" was returned by the grand jury in 1. There were 67 cases pending under this act at the close of the year.

Sixteen cases were reported to the Attorney General for prosecution under the act of March 3, 1905 (33 Stat. 1264), of which 1 was terminated by a fine of \$200 and costs, 1 by a fine of \$150, 1 by a fine of \$125, 5 by fines of \$100 each and costs, 6 by fines of \$100

each, and 1 by a fine of \$8. Of the cases pending at the close of the preceding year, 1 was terminated by a fine of \$300; 3 by fines of \$100 and costs, each; 4 by fines of \$100 each; 4 by fines of \$10 each; and 1 by a fine of \$1. Two cases were nolle-prossed, 2 were dismissed, and 2 were barred by the statute of limitations. Report of "no true bill" was returned by a grand jury in 1 case. There were 29 cases pending at the close of the year.

In all, 52 cases under the animal quarantine laws were reported to the Attorney General during the year and 103 cases were pending at the close thereof.

Cases disposed of by the imposition of fines

Number of cases	Fines	Total
2	\$1	\$2
1	8	8
5	10	50
3	25	75
2	50	100
44	100	4,400
1	125	125
1	150	150
2	200	400
4	300	1,200
65	-----	6,510

In each of the cases reported to the Attorney General for prosecution, a suggested form of indictment or criminal information was prepared and submitted therewith for use by the United States attorneys.

TWENTY-EGHT HOUR LAW (34 Stat. 607)

Four hundred and two cases were reported to the Attorney General under the 28-hour law.

Penalties aggregating \$53,825 were recovered in 539 cases. One hundred and seventy-eight cases were dismissed, 64 were determined adversely to the Government, and 2 were barred by the statute of limitations.

Five hundred and sixty-two cases were pending at the close of the year.

Penalties assessed under the 28-hour law

Number of cases	Penalty	Total
534	\$100	\$53,400
1	200	200
1	125	125
13	100	100
539	-----	53,825

¹ Lump penalty.

THE MIGRATORY BIRD TREATY ACT (40 Stat. 755)

Six hundred and thirty-eight cases were reported to the Attorney General under the migratory bird treaty act.

Fines imposed under the migratory bird treaty act

Number of cases	Amount of fines	Total
2	Costs.	
5	\$0.01	\$0.05
39	1.00	39.00
1	2.50	2.50
51	5.00	255.00
18	7.50	135.00
135	10.00	1,350.00
46	15.00	690.00
24	20.00	480.00
174	25.00	4,350.00
3	35.00	105.00
25	50.00	1,250.00
4	75.00	300.00
7	100.00	700.00
7	150.00	1,050.00
2	200.00	400.00
543	-----	11,106.55

In several cases defendants were sentenced to jail for terms ranging from one hour to two days. Defendants were acquitted in nine cases. One hundred and thirty-seven cases were either dismissed, nolle-prossed, or dropped. In six cases the statute of limitations ran before the informations were filed and a demurrer was sustained in one case.

THE LACEY ACT (Sections 241-244 of the Penal Code)

No cases were reported to the Attorney General under the Lacey Act. A fine of \$25 was imposed in one case coming over from the previous year.

NATIONAL FOREST GAME-PRESERVE LAW (39 Stat. 476)

Nine cases were reported to the Attorney General under the national forest game preserve law.

Fines imposed under the national forest game preserve law

Number of cases	Amount of fines	Total
1	\$15	\$15
5	25	125
1	50	50
1	75	75
1	100	100
9	-----	365

Four cases were dismissed or nolle-prossed and in one case a sentence of two months in jail was imposed.

BIRD-MAMMAL RESERVATION TRESPASS LAW (Sec. 84, Penal Code)

Twenty cases were reported to the Attorney General under section 84 of the Penal Code.

Fines imposed under section 84, Penal Code

Number of cases	Amount of fines	Total
1	\$1	\$1
5	10	50
3	15	45
1	20	20
10	-----	116

One case was dismissed and in another the defendant was sentenced to remain in the custody of the United States marshal for one day.

NATIONAL-FOREST GAME REGULATION (Reg. T-1)

A number of cases involving hunting and fishing on national forests in violation of State laws were reported to the Attorney General. Of these, 36 were closed by conviction and the imposition of fines and costs amounting in all to \$1,530.81. Defendants were acquitted in three cases. There were four cases pending at the close of the year.

ALASKA GAME LAW (43 Stat. 738)

Regulations of the Secretary of Agriculture and of the Alaska Game Commission governing the administration of the Alaska game law were reviewed and passed on by this office. Opinions were also rendered to the officials of the Bureau of Biological Survey on various legal questions arising in connection with the administration of the act.

THE GRAIN FUTURES ACT (42 Stat. 998)

A number of inquiries from the administrative officers and outside parties involving the interpretation of different phases of the grain futures act were answered during the year.

Assistance was given one of the attorneys of the Federal Trade Commission in the preparation of a brief in the suit filed by the Minneapolis

Chamber of Commerce to test the validity of an order issued by the Federal Trade Commission in a proceeding instituted by it prior to the passage of the grain futures act, requiring the chamber of commerce to "cease and desist" from the practice of excluding farmers' cooperative sales agencies from membership in the chamber. The order grew out of the action of the chamber of commerce in excluding the Equity Co-operative Exchange, a farmers' sales agency, from membership.

COURT CASES OF INTEREST

A second attack upon the constitutionality of the future trading act is pending in the Supreme Court. In *Hill v. Wallace* (259 U. S. 44), that act was held unconstitutional as to its regulatory features. (These were thereupon reenacted in the grain futures act.) The court did not pass upon section 3 of the act, which imposes a tax of 20 cents a bushel upon "puts and calls," "indemnities," and similar transactions. The suit now pending attacks this section of the act. Mr. Trusler, of Emporia, Kans., a member of the Chicago Board of Trade, filed the suit (300 Fed. 996) against the collector of internal revenue of Kansas City to recover a tax of \$200 on account of an "indemnity" transaction. He claims the tax is a penalty and not imposed for revenue purposes. The Federal district court held that as the tax is not associated with any regulatory provisions it is laid for revenue and not for regulatory purposes and is therefore valid. A direct appeal to the Supreme Court of the United States has been taken by Mr. Trusler. Information is that a motion to advance the case was allowed by the Supreme Court and that it will come on for argument early in the October, 1925, term.

UNITED STATES WAREHOUSE (ACT 39 Stat. 486)

Information relating to a number of alleged violations of the United States warehouse act was referred to the Attorney General with recommendations that criminal actions be instituted.

Regulations for storing dry beans, dried fruit, and sirup were reviewed, these three commodities having been added to those for which licenses under the act may be issued. Various forms were prepared for the use of the Bureau of Agricultural Economics, and advice, both formal and informal, was given to the bureau officials on questions raised under the act.

CASES OF INTEREST

The first conviction under the United States warehouse act was obtained in June at Sylvester, Ga., in the case of *United States v. A. M. Burts*. Burts, a warehouseman, was convicted of issuing receipts conveying the impression that his warehouse was licensed and bonded under the Federal act, when, as a matter of fact, his license had expired. A fine of \$100 was imposed.

United States v. Frank S. Gresham, in the western district of Oklahoma, was a criminal prosecution under the act for the issuance of alleged false and fraudulent warehouse receipts. A demurrer, based in part on the ground that the information failed to state a public offense, was filed, and overruled by the court. The court held that the warehouse act is constitutional. The jury returned a verdict of not guilty. The case is of general interest as being the first tried under the warehouse act, and because of the ruling of the court on the constitutionality of the act.

PACKERS AND STOCKYARDS ACT (42 Stat. 159)

Complaints in proceedings under the packers and stockyards act were reviewed in this office, and opinions, both formal and informal, upon various legal problems arising in the course of the administration of this statute, were rendered the officials charged with its enforcement.

FOOD PRODUCTS INSPECTION LAW (43 Stat. 822, 844-845)

Regulations governing the inspection and certification of various products under the food products inspection law were examined as to their legal sufficiency. Assistance was given the Bureau of Agricultural Economics in connection with its project for the standardization of trade terms, trade practices, and methods of adjustment. Advice and assistance were given on various questions arising in the administration of the law.

COTTON FUTURES ACT (39 Stat. 476)

A bill, S. 3107, to amend the cotton futures act was commented upon at the request of the chairman of the Senate Committee on Agriculture. The bill proposed that all commodity exchanges make their market quotations available to every one on equal terms unless intended for an illegal purpose. Attention was called to

court decisions having a bearing upon the matter, and suggestions for amendments to the bill were offered.

Another bill to amend the act was considered. This bill proposed that the buyer of a cotton futures contract should have the right to demand actual delivery of cotton during the delivery month but prior to the time now fixed by the exchange rules for settlement of future contracts.

Regulations of the Chicago Board of Trade governing dealings in cotton futures were reviewed on the informal request of its representative. The board opened its futures market last October with provision for delivery at either Houston or Galveston, Tex.

An opinion was given the Bureau of Agricultural Economics with reference to the relative standing of cotton class certificates issued respectively under the cotton futures act, the cotton standards act, and the food products inspection law.

Advice was given the bureau and outside parties upon other questions arising under the act and the regulations.

FEDERAL WATER POWER ACT (41 Stat. 1063)

Opinions rendered by the chief counsel of the Federal Power Commission and submitted to the Secretary of Agriculture for approval were reviewed and commented on. Action recommended by the Forest Service in a number of cases in which permits were issued prior to the passage of the Federal water power act were reviewed. An opinion was rendered with regard to the rights of a mining claimant in the matter of power development within the limits of his claim.

UNITED STATES COTTON STANDARDS ACT (42 Stat. 1517)

Advice was given the Bureau of Agricultural Economics that alleged types of cotton which were proposed by cotton associations for use in their respective communities were in reality cotton standards, as they were to be used generally and not individually. Advice was given the administrative officers on various other questions arising in the administration of the act, particularly those growing out of conferences here and abroad with representatives of the foreign cotton associations.

At the request of the bureau, a bill was prepared embodying the department's views with respect to investigations and studies to be made by

the department concerning standard weights and methods of packing cotton bales.

OPINION OF INTEREST

In an opinion of May 11, Acting Attorney General Beck advised that pursuant to the cooperative agreements with foreign cotton associations the Secretary of Agriculture may lawfully appoint members of the appeal boards of such associations, although they are not citizens of the United States, officers of the Department of Agriculture to determine the true classification of cotton and, as provided by the regulations promulgated under the act, make the certificate of their determination the final certificate of the Department of Agriculture within the meaning of section 4 of the act. In accordance with the usual practice in such cases, a brief was prepared and submitted to the Attorney General along with the request for the opinion.

UNITED STATES GRAIN STANDARDS ACT (39 Stat. 482)

Consideration was given to the suspension and cancellation of a number of licenses issued to persons under the grain standards act. Conferences were held with representatives of the Bureau of Agricultural Economics relative to the administration of the act, and advice, both formal and informal, was given. Reports from the bureau in three cases involving the violation of section 4 of the act were considered and referred, together with forms of informations prepared in this office, to the Attorney General, with recommendations that criminal proceedings be instituted. These cases are pending.

DECISION OF INTEREST

In the case of Shafer, attorney general of North Dakota, et al., v. Farmers' Grain Company of Embden et al., the North Dakota grain grading act of 1923 was declared by the Supreme Court of the United States to be a direct regulation of the buying of grain in interstate commerce, and therefore invalid. The act was attacked by grain buyers on the grounds that it interfered with and burdened interstate commerce and that it conflicted with the United States grain standards act. The court found that 90 per cent of the wheat produced in the State was shipped in interstate commerce, rendering the control of such business of concern to the people of other States as well as to those of North Dakota. The act prevented the buying of wheat by

grade except under certain prescribed conditions; required the buyer to separate dockage and return it to the producer unless distinctly valued and paid for; required the buyer who bought on credit to execute to the State a bond securing payment for all wheat so purchased; required the keeping of various records and furnishing data to State officers when requested, and authorized the State supervisor to investigate and supervise the marketing of grain and to make and enforce orders, rules, and regulations. The court held that in subjecting the buying for interstate commerce to the conditions and measure of control mentioned above the act directly interfered with and burdened interstate commerce and was an attempt by the State to prescribe rules under which an important part of such commerce should be conducted, and stated that this no State could do consistently with the commerce clause of the Federal Constitution.

CAPPER-VOLSTEAD COOPERATIVE MARKETING ACT (42 Stat. 388)

Various inquiries from outside parties as to the scope and effect of the Capper-Volstead Cooperative Marketing Act, particularly with reference to the Federal antitrust laws in relation to industries in which the writers were interested, were answered during the year. A summary of the provisions of the act was prepared and advice and assistance given the administrative officers in the interpretation of the act.

CENTER MARKET ACT (41 Stat. 1441)

Advice was given the superintendent of Center Market on a number of legal questions arising in the administration of the market.

COLLECTION AND DISTRIBUTION OF EXCESS PROFITS ON WOOL CLIP OF 1918

This fiscal year witnessed another step toward the completion and winding up of the work of collecting excess wool profits.

In view of the more or less concerted action of wool dealers in defending actions at law for the recovery of excess wool profits and their very evident intention of carrying some case to the United States Supreme Court for determination of the legal questions involved in this class of cases, it has been necessary in the trial of each

case, to make a record which would present fully to an appellate court the evidence supporting the validity of the regulations, as well as the department's interpretations of them. This has required the personal assistance of this office at practically all of the trials. To obviate the necessity of further attendance of a lawyer from this office at these trials, and to place these cases upon such a footing that they may be handled by the United States attorneys in regular course, it has been intended from the beginning to obtain, as early as possible, an authoritative judicial expression upon the general legal questions involved. To this end the case of *United States v. S. E. Avery*, which probably raised more general questions than any other, was tried in the northern district of New York in June, 1923. However, the court has not yet rendered its decision. With the same end in view, the trial of other cases was proceeded with as rapidly as they could be reached upon the dockets of the courts but the judgments were in favor of the Government and the defendants refrained from appealing. Finally, however, in the consolidated country dealer cases of *United States v. W. H. Gordin* and *W. H. Gordin*, administrator, tried in the southern district of Ohio in December, 1924, and in the central dealer case of *United States v. W. A. McFarland et al.*, reargued in the district of Maryland in February, 1925, judgments were adverse to the Government and appeals have been perfected to the Circuit Courts of Appeals for the Sixth and Fourth Circuits, respectively, and are there now pending.

The forward step is, therefore, that the very troublesome questions of law involved are now being presented to an appellate court in each class of excess wool profits cases, namely, those against country dealers and those against central dealers.

Most of the cases now awaiting trial involve large amounts. If the wool dealers' contentions should be sustained by the Supreme Court in either case now pending on appeal, it would become necessary materially to change the audits.

Other than advising administrative officers, conducting correspondence, and the like, the activities of the year with reference to this work have been the argument on demurrer of 1 case involving \$38,377.67, the reargument on the merits of another involving \$23,712.40, the trial of 2 cases involving

a total of \$6,425.29, the filing of briefs in 5 cases involving a total of \$90,832.00 the institution of suit in 1 case involving \$125,536.84, and the closing of 12 cases involving \$25,916.43.

The present status of the 69 excess wool profits cases which have been referred to this office since the inception of the work is: 11 are pending in this office and 3 in the offices of United States attorneys; 10 are awaiting trial in the United States district courts; 3 are pending in the circuit courts of appeals and 2 are awaiting decision on demurrer and 1 on the merits. Judgments are to be collected in three and in one a compromise was effected, but the money not yet received. In one a bill of discovery is to be filed and in another the Government's pleading is to be amended. The remaining 33 have been finally disposed of.

DECISION OF INTEREST

An important decision rendered during the year is that of United States *v.* Traugott Schmidt & Sons, 2 Fed. (2d) 290, wherein the United States District Court for the Eastern District of Michigan held that a central wool dealer, who had sold wool of the regulated clip to the Government and received the 4 per cent commissions thereon, was estopped to deny the validity of the regulations. This case

was argued orally and on brief by this office.

PATENTS

Twenty-two applications for letters patent on inventions of employees of the department were prepared and filed and 32 such applications were awaiting adjudication in the Patent Office at the close of the previous fiscal year. Twenty of the applications were allowed and 14 disallowed.

Interferences were declared by the Patent Office between applications for letters patent of several employees of this department and applications filed by outside parties. One of these cases was terminated by both parties agreeing to abandon the invention in such a way that the public became entitled to use it freely. Testimony in one case was taken in Washington and elsewhere. In many of the cases briefs were prepared and filed and oral arguments made before examiners and boards of the Patent Office on the various issues raised in them.

Many questions concerning patentability, validity, and infringement of inventions were presented to the office during the year, the solution of which involved much research work in the pertinent arts in the Patent Office and the giving of advice and opinions thereon.

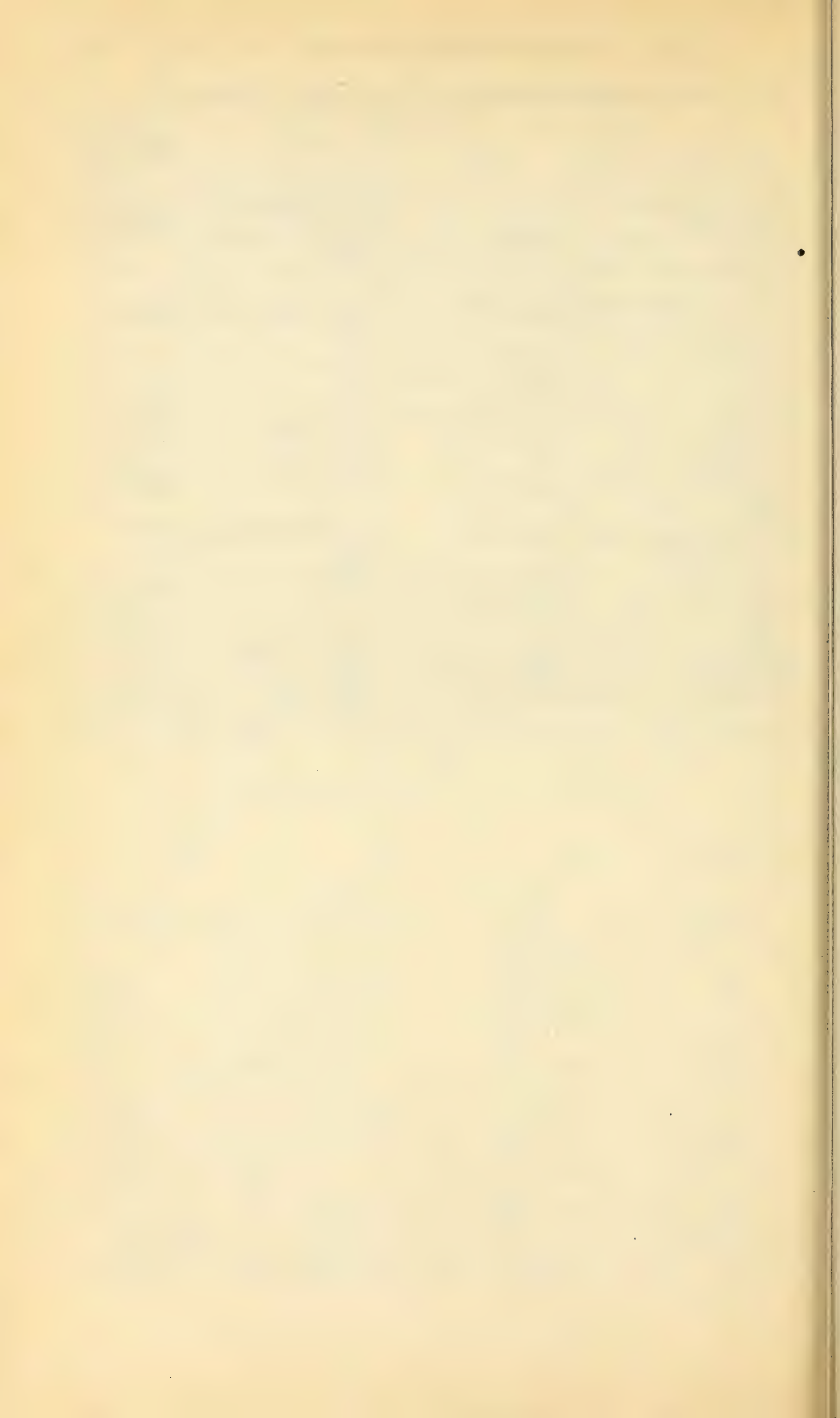
The accompanying table shows the status of applications on June 30, 1925:

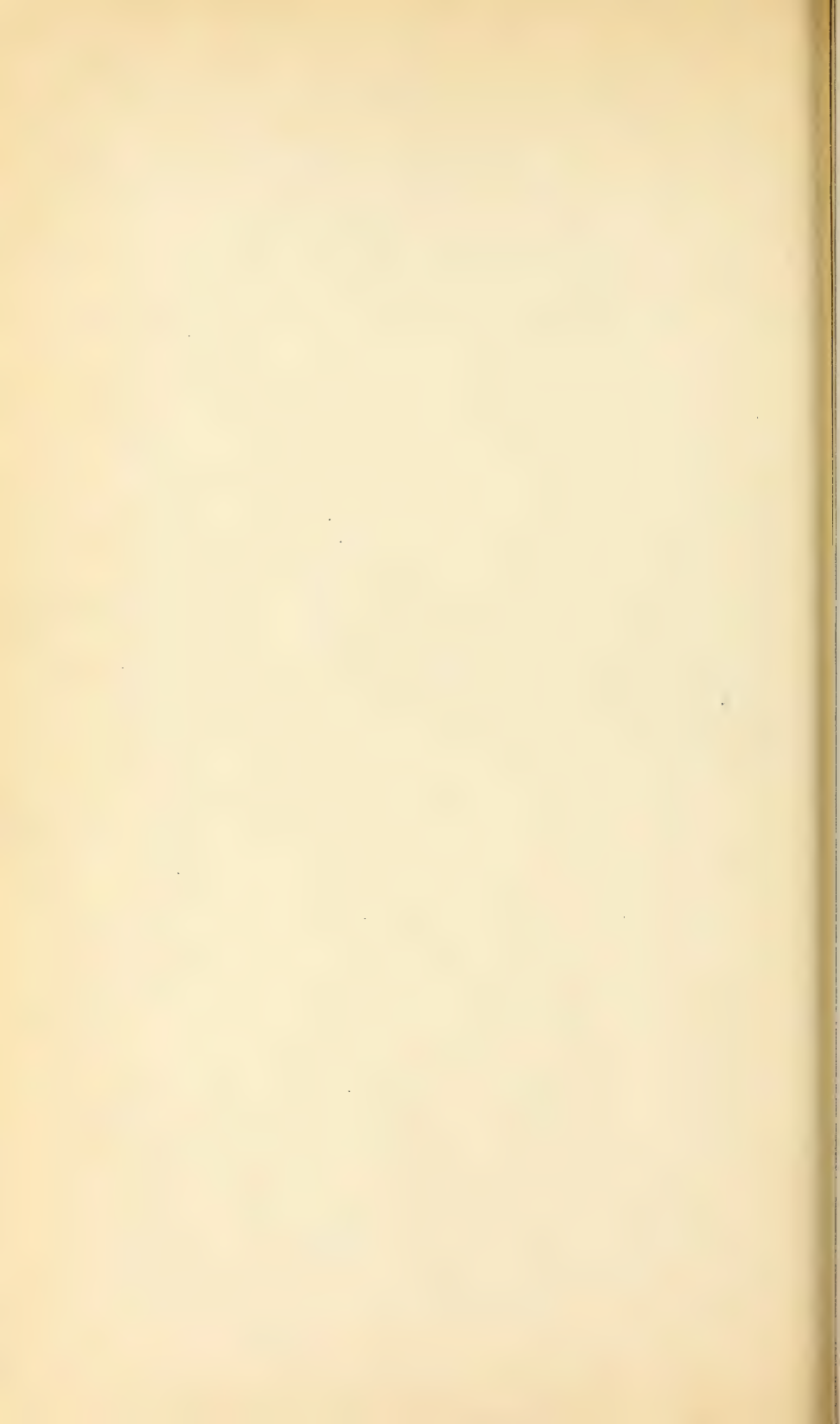
Patents applied for by members of the department

Applicant	Bureau	Invention	Disposition of application
G. F. Mitchell.....	Chemistry.....	Beverages.....	Pending.
F. C. Lincoln.....	Biological Survey.....	Bird trap.....	Disallowed.
H. S. Paine and J. Hamilton.....	Chemistry.....	Fondant.....	Allowed.
L. G. Carmick.....	Public Roads.....	Filler for cracks in concrete roads.	Disallowed.
W. V. Cruess.....	Chemistry.....	Fruit confections.....	Do.
H. C. Gore.....	do.....	Maltose.....	Do.
B. Drummond.....	Plant Industry.....	Support for branches.....	Do.
H. C. Gore.....	Chemistry.....	Sweet-potato product.....	Do.
Arno Viehoever and Ruth G. Capen.	do.....	Cantharidin.....	Do.
R. Thelen.....	Forest Service.....	Kiln.....	Allowed.
C. A. Richards and E. Bateman.	do.....	Pulp preservative.....	Pending.
H. S. Paine, C. F. Walton, and V. Birkner.	Chemistry.....	Cane sugar.....	Do.
A. T. Goldbeck.....	Public Roads.....	Foundation for roads.....	Do.
E. B. Smith.....	do.....	Accelerometer.....	Disallowed.
J. D. Rue, S. D. Wells, and F. G. Rawling.	Forest Service.....	Pulp.....	Pending.
H. Bryan, A. L. Mehring, and W. H. Ross.	Soils.....	Electric furnaces.....	Allowed.
R. Thelen.....	Forest Service.....	Kiln.....	Do.
Do.....	do.....	Wood seasoning.....	Do.
Do.....	do.....	do.....	Do.
P. A. van der Meulen.....	Entomology.....	Spraying material.....	Disallowed.
H. S. Paine.....	Chemistry.....	Confectionery.....	Pending.
S. E. Piper and H. E. Williams.	Biological Survey.....	Strychnine.....	Do.
T. A. Carlson.....	Forest Service.....	Board tester.....	Do.

Patents applied for by members of the department—Continued

Applicant	Bureau	Invention	Disposition of application
W. H. Ross, R. M. Jones, and A. L. Mehring.	Soils.....	Potassium phosphate and phosphoric acid.	Pending in interference.
Do.....	do.....	Phosphoric acid.	Disallowed.
H. S. Paine and J. Hamilton.	Chemistry.....	Confections coated with fondant.	Do.
F. W. Reynolds and J. Hamilton.	do.....	Fondant centers.....	Do.
L. W. Tarr and G. L. Baker.	States Relations.....	Pectin.....	Do.
E. Bateman and E. E. Hubert.	Forest Service.....	Stain preventer.....	Pending.
A. T. Goldbeck.....	Public Roads.....	Marking strip for concrete roads.	Allowed.
H. D. Tiemann.....	Forest Service.....	Kiln.....	Do.
M. E. Dunlap.....	do.....	Hygrometer.....	Do.
J. H. Cox.....	Agricultural Economics.....	Grain sieve.....	Do.
R. Thelen.....	Forest Service.....	Kiln.....	Do.
R. C. Roark.....	Chemistry.....	Fumigant.....	Pending.
E. N. Bates.....	Agricultural Economics.....	Aspirator.....	Allowed.
R. Thelen.....	Forest Service.....	Drying process.....	Pending.
W. V. Cruess.....	Chemistry.....	Glacéing fruits.....	Allowed.
C. H. Stephenson.....	do.....	Cleaning process.....	Do.
F. B. Power and V. R. Chesnut.	do.....	Insect attractant.....	Do.
G. E. Heck.....	Forest Service.....	Nail.....	Disallowed.
C. H. Popence and E. H. Siegler.	Entomology.....	Insecticide.....	Pending.
F. G. Rawling.....	Forest Service.....	Corrosion preventer.....	Allowed.
W. R. Barger, W. V. Hukill and L. A. Hawkins.	Plant Industry.....	Apparatus for disinfecting fruit.	Pending.
J. W. Turrentine.....	Soils.....	Iodine.....	Do.
Do.....	do.....	Decolorizer.....	Do.
R. Thelen.....	Forest Service.....	Kiln.....	Allowed.
Do.....	do.....	do.....	Do.
Do.....	do.....	do.....	Do.
Do.....	do.....	do.....	Do.
M. E. Dunlap.....	do.....	Plastic composition.....	Pending.
J. F. Brewster.....	Experiment Station.....	Decolorizing carbon.....	Do.
W. D. Smith.....	Agricultural Economics.....	Grain tester.....	Do.
H. R. Fulton and J. J. Bowman	Plant Industry.....	Decay preventer.....	Do.
F. H. Jackson.....	Public Roads.....	Cement tester.....	Do.





REPORT OF THE DIRECTOR OF THE EXTENSION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE,
EXTENSION SERVICE,
Washington, D. C., September 25, 1925.

SIR: I have the honor to present herewith the report of the Extension Service for the fiscal year ended June 30, 1925.

C. W. WARBURTON,
Director.

HON. W. M. JARDINE,
Secretary of Agriculture.

ORGANIZATION

The Extension Service has continued during the year on practically the same basis as in 1924, with the exception that the office of demonstrations on reclamation projects was transferred to it by order of the Secretary on August 16, 1924. This small unit conducts extension activities on Federal reclamation projects in the Western States. The object of the transfer was to correlate the activities of this unit more closely with the extension work of the department and the several States in which reclamation projects are located.

PERSONNEL

The personnel of the Extension Service in Washington on June 30, 1924, consisted of 172 persons, of whom 5 were employed in the office of the director, 112 in the office of cooperative extension work, 27 in the office of exhibits, 21 in the office of motion pictures, and 7 in the office of agricultural instruction. The field force of the Extension Service on the same date consisted of 3,771 persons, of whom 3,752 were cooperatively employed by the department and the States in extension activities. The field staff of the office of demonstrations on reclamation projects consisted of 8 persons;

2 were full-time employees of the office of cooperative extension work, and 9 were employed by the office of exhibits. In addition to the persons employed cooperatively by the department and the States, about 1,000 are employed in extension work in the States who are not under appointment from the department.

FUNDS ADMINISTERED

The direct Federal appropriation to the Extension Service during the fiscal year was \$1,599,172, of which \$1,307,940 was for farmers' cooperative demonstration work, \$153,712 for salaries and administrative expenses, \$99,880 for exhibits, and \$37,640 for demonstrations on reclamation projects. Other bureaus of the department made available \$36,912 for extension work, making a total of \$1,636,084 in direct Federal appropriations. In addition, Federal appropriations amounting to \$5,880,000 were allotted to the States for extension work under the terms of the Smith-Lever and supplementary acts. The States, counties, and other agencies supplied \$12,387,555 for cooperative extension work. The grand total of all of these items, the sum available for extension work in the United States during the fiscal year, was \$19,903,639.

COOPERATIVE EXTENSION WORK

PERSONNEL

Few changes have occurred in the organization of the office of cooperative extension work or in its personnel during the year. C. B. Smith has continued in charge of the work, with J. A. Evans as assistant chief.

On June 30, 1925, the Washington staff consisted of 10 administrative and supervisory officers, 12 organization field agents, 10 subject-matter field agents, and a clerical staff of approximately 80 people. Eleven temporary clerks were employed for a three months' period in the section of reports and efficiency studies to assist in summarizing the 1924 reports, as compared to 20 clerks the preceding year. This reduction in temporary employees was made possible by the States assuming responsibility for more of the tabulating and resulted in a saving of approximately \$3,000 to the Federal Government.

I. O. Schaub, regional leader in the Southern States, resigned July 15, 1924, to become director of extension in North Carolina. He was succeeded by O. B. Martin, who has been connected with extension work in the South for many years. On July 1, 1924, R. A. Turner, specialist in boys' and girls' club work, was added to the force. F. P. Lund, specialist in food preservation, has been on furlough the entire year in Denmark and other European countries, introducing American methods of extension work in agriculture and home economics. This work is being done at the request of the International Education Board. J. A. Evans asked for and was granted a furlough at the end of the year for the purpose of making a study for the Portuguese Government of the possibilities of cotton growing in the colonial possessions of that country in southeast Africa.

The entire State field service on June 30, 1925, numbered 4,860 persons. Of this number, 3,447 were permanently located in the counties, 2,167 being in county agent work, 875 in home demonstration work, 129 in boys' and girls' club work, and 276 in extension work with negroes. The county workers were assisted in their work by 721 full-time and 209 part-time subject-matter specialists located at the State agricultural colleges. There were 430 persons employed as supervisors and assistant supervisors, while the administrative officers and their immediate assistants numbered

53. Of the above total, 3,752 were cooperative employees of the office of cooperative extension work, practically all engaged either in county work, supervision of county work, or farm management demonstrations.

FUNDS

The total funds from all sources available for cooperative extension work during the fiscal year ended June 30, 1925, were approximately \$19,612,407, or about \$500,000 more than for the previous year. Of this amount 36.8 per cent, or \$7,224,852, was contributed by the Federal Government, exclusive of the use of penalty envelopes; and 27.8 per cent, or \$5,449,572, was derived from State appropriations to the agricultural colleges and other State agencies. The remaining 35.4 per cent, or \$6,937,983, came from county appropriations for extension work and from contributions by local organizations and individuals. About 92 per cent of all funds used for cooperative extension work in 1925 came from public sources.

Of the Federal funds \$5,880,000 was made available by the Smith-Lever Act and other appropriations supplementary thereto, \$1,307,940 from direct appropriations to the office of cooperative extension work, and \$36,912 from other appropriations to the Department of Agriculture. Of the total funds \$12,300,124 (62.7 per cent) was allotted for extension agents in the counties; \$1,269,642 (6.5 per cent) was allotted at the State agricultural colleges for administration; \$2,129,445 (10.9 per cent) for supervision of county extension forces; and \$3,550,399 (18.1 per cent) for the employment of subject-matter specialists to supplement the county workers. The remaining 1.8 per cent, or \$362,797, was for use in connection with the activities of the Federal Extension Service located at Washington. A considerable part of the money expended in Washington and at the State agricultural colleges was for penalty envelopes, report forms, circulars, and other supplies largely consumed by the county extension workers.

PROGRESS

Progress for the year has lain chiefly in the increasing recognition of the value of the local leader in extension work and of the need for giving training to such leaders. There were 37,905 local leaders for junior

and 145,012 local leaders for adult work in 1924,¹ a total of 182,917 volunteer local leaders aiding the regular extension forces in carrying on extension work. Over 75,000 of these leaders were women.

Substantial progress was also made in club work. Enrollment was increased by more than 51,000, and the percentage of those completing the year's work was increased slightly over 1923. The juniors put on about 60,000 more result demonstrations in 1924 than in 1923, while in the adult work there were about 75,000 less demonstrations than in 1923. It is possible that there is some relation between these figures, as quite generally county agents had been urged to give more time to junior work.

Three regional conferences were held during the year. In November, 1924, extension workers of the 11 Western States met at Tucson, Ariz., to review the progress made during the year in carrying out the regional program adopted at Fort Collins, Colo., in 1923, relating to range livestock, human nutrition, and dairying, and took steps to continue and strengthen this work. Agronomy was added to the list of subjects given special consideration at the Tucson conference. Manuscript for a range handbook has been prepared in furtherance of the western extension program and is ready for the printer.

The Eastern States extension workers held a three-day extension conference at New York City in February, 1925, devoted to nutrition, soils and crops, and dairying. The North Central States held a three-day farm management conference at Sioux City, Iowa, in May, 1925. No regional conference was held in the South.

During the year the office has cooperated with the various bureaus of the department in getting together the results of research which are ready for extension work. This material will be published as a handbook for the use of all extension forces.

FIELD STUDIES AND REPORTS

The farm and home surveys to determine the extent to which rural people are putting into practice extension teachings, first made in Iowa and New York in 1923-24, have been

extended during the year to Colorado, California, Massachusetts, and New Jersey, under the general supervision of M. C. Wilson. Plans have been completed for making similar field studies in Georgia, Alabama, and Wisconsin during the late summer and fall of 1925. Four other States have requested assistance in conducting field studies of the same general character.

In this work 10 members of the office staff and 80 members of the State extension services have participated in the collection of field data. The benefit to those participating in the collection of field data has been very great, according to statements made by extension directors indicating that the training of extension workers in extension organization, methods, and terminology is by no means an unimportant by-product of the field studies.

In three of the States—New York, Colorado, and California—a record was made of the attitude of the farming people toward extension. Sixty-six per cent, two farms out of three, were reported favorable. Twenty-four per cent, or one out of four, were reported as indifferent or lukewarm to the work. Actual opposition was noted in 4 per cent of the cases, or on the part of only 1 farm in 25. No attitude was reported for the remaining 6 per cent.

These studies clearly indicate that satisfactory progress has been made by the extension organization in reaching rural people, and they also point out equally clearly the remaining task of getting more farmers and home makers to accept extension teaching, and all to adopt more improved farm and home practices.

Extension accomplishments.—A somewhat different plan has been followed this year than heretofore in compiling national results of cooperative extension work. All of the States were invited to tabulate their county reports and submit State summaries of the different lines of work. Thirty-two States responded, the reports from the remaining 16 being tabulated in the usual way by the section of reports and efficiency studies. The plan worked fairly satisfactorily and it is hoped will be adopted by all States in 1925.

Of the 76,350 communities in the counties from which reports were received, 49,464 were reported as having programs of extension work determined by the extension agents in consultation with the local people. The

¹ Reports of all extension agents are for the calendar year, hence figures contained in this report, except those in foregoing paragraphs, are for the year ended December 31, 1924, rather than for the fiscal year ended June 30, 1925.

paid extension workers were assisted in their work by 182,917 voluntary leaders recruited from the ranks of local farmers and farm women. Membership in adult extension clubs or groups totaled 557,347. Boys' and girls' clubs to the number of 38,120 were organized, with 510,355 different boys and girls enrolled in agricultural and home economics projects. Personal calls by the agents were made on over 700,000 farmers and more than 230,000 home makers. Personal interviews with agents at their offices were reported to the extent of more than 3,000,000, with more than 2,160,000 telephone calls in addition. Over 3,760,000 personal letters were written in connection with requests for information. Nearly 19,000,000 persons attended the 623,000 meetings arranged for or participated in by extension workers.

Nearly 4,000,000 improved farm and home practices were reported adopted in 1924, or approximately 1,500,000 less than during the preceding year. This decrease is owing partly at least to elimination of duplicate reporting and to incomplete information from a few States.

The largest increases in number of adult demonstrations conducted in 1924 over 1923 were in soils, forestry, rural engineering, home management, and house furnishings. The largest decreases were in horticulture, poultry, clothing, home health and sanitation, and miscellaneous.

In the case of junior demonstrations, the chief increases in projects completed in 1924 over 1923 were in potatoes, cotton, and other special crops, dairying, foods and nutrition, home health and sanitation, and miscellaneous. The principal decreases were in horticulture and animal husbandry.

The number of improved practices adopted in 1924 as compared with 1923 was larger in the case of forestry, dairying, rural engineering, rodent and insect control, home management and house furnishings, home health and sanitation, and miscellaneous. The largest decreases were in cereals, potatoes, cotton, and other special crops, horticulture, agricultural economics, foods and nutrition, and clothing.

Digests of narrative reports.—The more than 4,000 narrative reports of State administrative and supervisory officers, State subject-matter specialists, and county extension agents have been indexed according to the plan followed in previous years. Digests of these narrative reports have been prepared

for the use of representatives of the Federal Department of Agriculture and for State and county workers. These briefs for the most part have been typewritten for limited distribution, although in a few cases the material has been mimeographed for general distribution. The topics covered are as follows:

From 1923 reports—

- Alfalfa.
- Apiculture.
- Clover, red.
- Cooperative tomato marketing.
- Cover and green manure crops.
- Cow testing associations.
- Demonstrations.
- Food preparation.
- Forestry.
- Irrigation.
- Kitchen arrangement and equipment.
- Landscape gardening.
- Melons.
- Motion pictures, use of.
- Recreational activities.
- Soybeans.
- Supervisory programs.
- Sweet potatoes—Fertilizer.
- Weeds.
- Wheat seed treatment.

From 1924 reports—

- Better sire campaign.
- Child feeding.
- Community buildings.
- Cotton—
 - Campaigns and contests.
 - Fertilizer.
 - Improved seed and varieties.
 - Insects and diseases.
- Exhibits.
- Livestock range improvement.
- Local leadership.

Farmers' institutes.—Information relative to farmers' institutes conducted in 1924 has been collected from the State agricultural colleges and the State departments of agriculture by J. M. Stedman. The 21 States conducting institutions held an aggregate of 3,514 institutes, comprising 10,387 sessions, which were attended by 1,474,966 persons. The cost of these institutes was reported as \$121,208, of which approximately three-fourths came from State sources and one-fourth from local sources.

Foreign extension activities.—Mr. Stedman has also been responsible for reviewing publications relating to extension work in agriculture and home economics in foreign countries. Two reports have been prepared, one for the six-months period ended January 1, 1925, and the other for the similar period ended July 1, 1925. The latter

report contains an index of all similar reports prepared during the past six years.

VISUAL INSTRUCTION AND PUBLICATIONS

The visual instruction and editorial section of the office continued to handle matters relating to visual instruction, publications, press material, radio, photographs, lantern slides, charts, motion pictures, exhibits, and other illustrative material under the leadership of Reuben Brigham.

Publications.—The following publications were prepared by the office of cooperative extension work and printed during the fiscal year: Cooperative Extension Work, 1922; Cooperative Extension Work, 1923; Boys' and Girls' Club Work, 1922; Home Demonstration Work, 1922; Extension Work in Plant Pathology, 1923; Extension Work in Agricultural Engineering, 1923; An Extension Program in Crop Production to Reenforce Range Livestock, Dairying, and Human Nutrition for the Western States. The following circular was reprinted: A System of Field and Office Records for County Extension Workers.

Information service.—Cooperating with the department press service, the section assembled and prepared 288 articles relating to various phases of extension work. These articles appeared in the Official Record, the Department Clip Sheet, and other press mediums. The picture news service to farm papers and magazines relating to national and regional developments in extension work, which was being developed in 1923, was further expanded. Over 500 photographs, with supplementary extension information, were furnished for news purposes during the year.

Visual instruction.—At the request of State extension divisions short talks were given on methods of extension photography and on the preparation and use of illustrative material at conferences of extension workers in Iowa, Kentucky, Kansas, Michigan, Minnesota, Missouri, New Jersey, North Dakota, Ohio, Oklahoma, South Dakota, West Virginia, and Wisconsin.

In cooperation with the State extension divisions several carefully planned series of field photographs illustrating extension work were obtained for use in publications, information service and exhibits, and for distribution in lantern-slide form. In this work 16 States were included, as follows: Alabama, Florida, Iowa, Kan-

sas, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Tennessee, and Virginia. On these trips 1,860 new field photographs were taken.

The photographic reference file, which includes illustrations on a wide variety of agricultural and home-economic subjects available for the use of its Washington and field employees and cooperators, at the end of the year comprised 25,497 photographs, 3,348 new illustrations being added during the year.

In cooperation with subject-matter bureaus of the department 18 series of lantern slides were prepared for use of extension workers on the following subjects: Judging draft horses; A guide to fabric selection; Transferring bees; Milk for the farm home; Production of clean milk; 4-H club camps; Extension photography; Alfalfa weevil; Range management on the national forests; Plumbing for the farm home; Food makes the difference; Beef slaughtering and cutting; Cow-testing associations; Roundworms and swine sanitation. The preparation of approximately 20 other series of slides is in progress. The following series have been revised during the year: How to make good farm butter; Cattle-tick eradication; Types and breeds of beef and dual-purpose cattle; Breeds of horses; The swine project in vocational agriculture; Breeds of sheep. During the year 815 sets of slides were distributed to State extension divisions.

Nearly 40,000 negatives, prints, slides, enlargements, charts, posters, and drawings were requested and prepared for use in extension work. Requests for the preparation of illustrative material received for this section by the office of publications included 3,667 negatives, 28,652 prints, 7,518 slides, 678 enlargements, and 447 miscellaneous items, inclusive of blue prints. In the section 1,713 lantern slides, 275 charts, drawings, and designs also were prepared.

In cooperation with the office of motion pictures, two extension motion pictures were completed, as follows: Touring with the Grangers; A Crop Worth Saving.

In cooperation with the office of exhibits, material was prepared for the interstate boys and girls' club exhibit at Sioux City, Iowa.

Radio.—A radio questionnaire was sent to extension workers at the request of the Bureau of Agricultural Economics during June, 1925, the re-

sults of which have not yet been tabulated. As a result of a similar questionnaire, sent out in the spring of 1924, a summary was prepared showing that of 944 extension agents making replies, 151 had radio receiving sets and 482 had access to receiving sets. From the data obtained in the questionnaire it is estimated that 364,800 farm families were using radio receiving sets in 1924.

SUBJECT-MATTER SPECIALISTS

No additions were made to the corps of subject-matter extension workers during the year, the number remaining at 10, as in 1923. The work has continued under the general charge of A. B. Graham.

One purpose of these workers is to organize the investigational results of the several bureaus of the department into form for use by the extension services of the several States. The subject-matter specialists, in cooperation with the investigational forces of the bureaus, determine the means and agencies by which the results of research may best be extended. They also assist in preparing publicity and other general information for extension use. Four members of the staff prepare material for mimeographed publications such as *The Extension Horticulturist* and *The Extension Pathologist*, setting forth the methods advocated by the department and those in use by State specialists. By these and other means the best extension methods are made available to all workers. The specialists also review all projects submitted by the States which relate to their particular line of work. In their visits to the States they give further study, through personal observation, to extension methods, agencies, and plans. Where funds are not yet available to employ a subject-matter specialist, certain persons within the bureaus have sometimes been designated to give particular attention to plans, surveys, and reports of extension work related to bureau activities. In some instances these persons have prepared annual reports on extension work in their subjects.

The extension subject-matter specialists have attended various subject-matter regional conferences. In November, 1924, a conference was held at Tucson, Ariz., in which the extension specialist in agronomy cooperated with the State extension specialists in formulating an extension program in agronomy for the 11 Western States. The nutrition specialist also

cooperated with the State nutrition specialists at the same conference. The nutrition specialist and the farm management specialist cooperated in a similar conference in New York City in February, 1925, where plans for furthering these two lines of work were developed in cooperation with nutrition and dairy specialists from the Northeastern States. At Sioux City, Iowa, in May, 1925, the farm management specialist cooperated with State farm management specialists in further developing their plans and methods agreed upon at a conference in Chicago a year previous.

The subject-matter specialists have cooperated with the office of exhibits and the office of motion pictures in the preparation of exhibits and motion-picture films prepared for the extension field.

A decidedly increased interest has been manifested during the year in the study of the needs of boys' and girls' club work, and also the means and agencies whereby this work can be more successfully promoted from a subject-matter standpoint. Subject-matter specialists cooperate with each other in coordinating their efforts; they think of the farm as a unit rather than of their various interests as merely isolated features of that unit. Extension specialists frequently consulted with each other to determine the relationships of their particular interests.

Nearly 900 part-time or full-time extension specialists were employed by the States, as follows:

Agronomy-----	105
Animal husbandry-----	81
Clothing and millinery-----	59
Dairying-----	95
Entomology, including bee-keeping-----	37
Farm management-----	48
Foods and nutrition-----	57
Home economics, general-----	13
Home management-----	22
Horticulture-----	81
Marketing-----	42
Plant pathology-----	34
Poultry-----	83
Rodent control-----	7
Rural engineering-----	47
Veterinary medicine-----	10

Accomplishments in several of these lines of work are described in the paragraphs which follow:

Agronomy.—In 1924, as in 1923, seed improvement and the growing of legumes were the most outstanding activities. The development of near-by sources of lime to make its use less

expensive has perhaps ranked next. The seed improvement work and the distribution of high-class seed have developed from a system of inspection and certification. This work, in many of the States, was begun by the extension agronomists, who later gave way to commercial agencies or to associations in their activities in promoting it. These agencies are conducting the work with a scale of charges for inspection and certification of such grains as corn, wheat, oats, and rye, and grass seeds. The work in soil fertility, which includes the application of commercial fertilizers, lime, and manure, has continued to claim much of the attention of the county agents and the agronomy specialists. Manufacturers and distributors of commercial fertilizers have joined with the investigators and extension workers in recommending the use of high-grade fertilizers. Conferences to bring about this result were promoted by extension and research agronomists.

Horticulture.—The pruning and spraying of orchards has continued to be the chief horticultural extension activity. In many States demonstrations in pruning and spraying were made by the specialists and county agents. Plant pathologists, horticulturists, and entomologists have shown increased interest in cooperative plans for spraying in commercial orchards. Additional service has been given by the Weather Bureau in forecasting weather conditions in important fruit-producing regions, and recommendations for the application of sprays have been correlated with these forecasts. Increased interest was shown during the year in the care and fertilization of the farm orchard and in the raising of small fruits. This increased interest, as well as greater production of vegetables in farm gardens, may be due in part to campaigns by nutrition specialists for increased variety in the diet in farm homes.

Extension horticulturists have cooperated with extension pathologists in extending the best methods in plant-disease control. Some interest has been taken by extension horticulturists in the introduction of standard names for varieties and in the more general standardizing of vegetables, especially those for canning. This has brought about renewed interest on the part of seed growers and dealers in the standardization of vegetables for both commercial and home use.

Plant pathology.—In very few States is the extension work in plant pathology solely in the hands of the exten-

sion plant pathologist. In most States the plant pathologist cooperates with the production specialists in agronomy, horticulture, vegetable growing, and forestry, with the expectation that they will extend the most commonly known practices for control in their particular fields. By this plan the extension plant pathologist can reserve his time for clarifying old methods and establishing new ones, where the problems of plant disease are so great that they require intensive attention.

The methods of control practiced in others years have been developed further during 1924, such as (1) locating disease-free stock, (2) growing these stocks in selected fields, (3) conducting field and bin inspections, (4) training inspectors, (5) conducting test plots with seeds planted for certain uses, and (6) teaching by means of newspaper articles, tours, exhibits, and other agencies.

During the year there has been a marked increase in the quantity of material prepared by extension workers for the use of county agents, farmers, and others on the control of plant diseases. Seed dealers have shown greater interest than ever before in obtaining disease-free stocks of seeds. The cooperation of plant pathologists with seed distributors and the publicity that has resulted in the sale of pure seeds is gradually eliminating one of the great wastes on the farm, that of loss from plant diseases.

Animal husbandry.—In 1924 the livestock business had not sufficiently emerged from its precarious condition to make extension work in animal husbandry much more than that of holding the ground already gained. The necessity for economies in livestock production caused extension workers to emphasize more effective and economic methods of feeding. It also had a tendency to promote a greater interest in the organizing of cooperative shipping associations. Drought in the Far West and Southwest, and a poor corn crop in the North Central States, gave some feeling of depression to livestock production on an extensive scale. The decline in the hog market and the scarcity of good feeding corn resulted in decreased production of hogs. These conditions left the extension work in swine husbandry at low tide, but the more optimistic swine-husbandry specialists and breeders looked forward to improved conditions in the near future.

The outstanding feature of extension work with sheep has continued to

be the spread of the practice of docking and castrating lambs. This has been emphasized particularly in Kentucky, Virginia, Tennessee, and Missouri. The Federal extension specialist in animal husbandry has visited the sections of Tennessee and Virginia where this practice has been encouraged, and has been in close touch with the buyers in eastern lamb markets. Gradual recognition of this work is shown on the markets by slightly increased prices.

In dairy husbandry, the cow-testing associations, the growing of legume feeds, and the making of a better quality of silage have shown a slow but steady growth during 1924. The bull-association work has had a steady growth and is still to be commended because of its reasonable certainty to increase milk production. There has been a gradual increase in the better care of milk and cream, both for the milk market and for manufacture into high quality butter and cheese. The dairy extension specialists have co-operated with the nutrition specialists in encouraging farmers who do not own cows to obtain enough to provide the family with milk and butter. Demonstrations with children to bring them to normal weight by the addition of milk to their diet have stimulated a much larger use of milk in the home.

Extension methods in poultry husbandry have shown increased results in the production of eggs and in the raising of a better type of market fowls. Culling seems to have become a well-established practice in many parts of the country. The grading of eggs has gained considerable ground because of increased prices offered by buyers for eggs that grade up to tentative standards established by the Federal Department of Agriculture. However, there is much room for improvement along this line. Farm journals, county newspapers, and special poultry publications helped very materially by publishing stories of good poultry management as practiced by both adults and boys and girls. Automobile tours and county fair exhibits have stimulated adult interest in poultry raising.

Farm management.—In keeping with the general plans outlined at some of the regional conferences last year, farm-management demonstrations have held quite closely to the keeping of accounts, the determining of costs, and farm-management extension schools where records have been discussed and

recommendations have been made for certain adjustments in the management of the farm.

For the demonstrations in account keeping books are furnished, usually by the college of agriculture, at a nominal cost. This work is for the purpose of establishing the habit of record keeping and to serve as a guide in considering each farm enterprise. The gradual increase in the use of machinery and the increased acreage per worker have continued to a small degree throughout 1924. In the handling of farm machinery it has been learned, through farm-management specialists and from other sources, that the lifetime of this machinery can be extended by buying parts to take the place of those parts showing the greatest degree of wear. There has been a general relaxation of the practice of trading an old machine for a new one where repairs for the old one can be obtained at reasonable prices.

Marketing.—During the year there was a general increase in the calls for service in point-of-origin and terminal inspection. The point-of-origin inspection has brought to the producer more clearly than ever the necessity of producing commodities of such quality as will pass this initial inspection. This has also stimulated cooperative marketing associations and has given stability to them in that it has afforded these organizations a much-needed protection against terminal market practices that were not always fair to the shipper. There has been a gradual raising of quality in the marketing of eggs because of the introduction of standards whereby the individual shipper and the cooperative shipping organizations could meet the demands of the large consuming markets. Cooperative shipping associations for livestock and other cooperative organizations for the marketing of fruits, vegetables, and some types of tobacco have often increased the returns to the producer very appreciably. The wool pools in the principal woolgrowing States are growing in favor. Greater familiarity with commodity grading and the buying and selling practices of the business world, gained through the operations of cooperative marketing associations, has proved very helpful to producers in bringing about more favorable relationships with dealers and with transportation and credit agencies.

Forestry.—During 1924, 11 States had forestry extension projects. The de-

velopment of State nurseries, thereby making planting material easier to obtain, has fostered a planting program in many States up to the limit of the capacity of marketable material from the nurseries. The planting of wind-breaks in the plains and prairie regions and the production of fence posts have continued to receive the greatest attention. In the South there has been a renewed interest in reforesting rough areas which have been cut over by the large lumber companies. In many cases the State department of forestry, the county agent, and the farmer have cooperated in the development of planting plans. The care of the farm woodland has, however, grown in favor in all of the States lying in the natural woodland areas of the eastern, central, and southern parts of the United States. The products of the farm woodland are coming gradually to be considered as much a product of the farm as are the cereals and livestock. The general looking forward to Federal aid in forestry extension work has quickened many of the States to develop their nurseries more extensively and to give greater attention to the farm woodland. The creosoting of fence posts and other timbers likely to be exposed to decay increased very rapidly during 1924. In one of the States where sheep raising has been stimulated, thereby increasing the amount of fencing, post preservation has been a major project of the forestry extension specialists.

Rural engineering.—During 1924, as in years previous, the increase of the productive power of the land by drainage, terracing, irrigation, and clearing of stumps has progressed very gradually in keeping with the idea that the producing power of land per man and per acre may be increased by providing artificial barriers against losses from flooding, washing, and drought, and facilitating tillage by the removal of roots and stumps. The lifetime of farm machinery has been increased by teaching the best methods of caring for it and repairing it.

The plan of having field meetings to observe the changes made in the producing power of drained, terraced, or irrigated land or stump-cleared fields has been continued. In these meetings the methods of conducting the work are again explained to the people, and the benefits to be derived are plainly evident to them. In the Central and Southern States terracing has been promoted by means of demonstrations and terracing schools. Motion pictures have been used to show

some of the methods of terracing. Instruction has also been given in the use of drags, levels, and rods, each of which is necessary to the laying out of terraces.

Building plans for hog houses, poultry houses, dwellings, and barns, as well as plans for the installation of water systems, dumb waiters, and various other household conveniences, have been distributed throughout the year. The use of the kitchen score cards and other methods of determining the rating of farm-home equipment has stimulated the request for remodeling plans and detailed plans for mechanical devices.

Clothing and millinery.—Demonstrations in the proper selection of clothing material, with special reference to the use to be made of it, have been continued throughout the year. Construction work by the use of adjusted commercial patterns and homemade dress forms have had a normal growth without extra stimulation. Both of these forms of work have passed well beyond the propaganda stage. The furnishing of a girl's room has stimulated a greater interest on her part in sewing along lines other than garment making. In clothing, as in millinery, many demonstrations have been made in local leader-training schools and in other groups of women to bring out the adaptability of goods of a certain color and figure. Trimmings for both dresses and hats to harmonize with complexion, stature, and general conformation have also been demonstrated.

In millinery the training of local leaders and the conducting of hat construction and trimming schools have progressed gradually during the year. The work in millinery has accomplished two outstanding results—development of better taste in the construction and trimming of hats to fit the face as well as the head of the individual and the saving of money.

Home management.—Home management, from the financial aspect on the farm, has become an integral part or feature of farm management. While the work has been conducted as a separate feature, applied to the home, it connects itself closely to the farm-management work, because many of the resources entering into home management are the products of the farm. Demonstrations have been conducted in budget making, both from the standpoint of economy and to teach the relative importance of certain necessities in the home. It has also tended to make the home maker dis-

tribute her time and money more systematically. Devices for saving energy, steps, and time have been demonstrated. Kitchen rearrangement and the installation of new or better equipment have often resulted from the use of the kitchen score card. The installation of running water and septic tanks and the adjustment of the height of sinks and tables have been brought about through the cooperation of the home-management specialists with the rural engineers. The rural engineer in one State has given most of his time to the installation of septic tanks. This specialist usually brings the local plumber to his assistance, so that local aid in the building of such tanks is available if desired.

Business men have cooperated with home-management specialists in the loan of material for demonstration purposes in the homes and for exhibit purposes at various other meetings.

Home health.—Home-health demonstrations have been confined to the introduction of simple health practices in the home, and the correction of certain physical conditions about the home that would lead toward better health. Therefore, encouragement has been given to the screening of doors and windows in many parts of the country where this feature has been neglected. Ventilating of sitting rooms and especially of bedrooms in farm and village homes has been advocated. Demonstrations have been made in the drainage of low, wet places near residences and in the removal of discarded receptacles where mosquitoes may breed. Simple demonstrations have been made in the general care of the sick room and in methods of changing linen on the beds of sick persons.

Very simple first aids have been demonstrated, all of which have been of a nature to show how help may be rendered until a physician arrives.

Nutrition.—The use of height and weight standards as applied to children has made parents aware of the lack of proper physical development. Feeding demonstrations have overcome in a large measure the wide difference between the condition of these children and the standards set up for their respective ages and heights. Although the application of these height-weight standards is sometimes questioned, they set up at least a rough measure whereby the interest of parents can be aroused to the need for a wholesome and well-balanced diet. The effects of this work have spread among

school children and young boys and girls in club work.

The presentation of the four different types of food, either by picture or exhibit, has simplified the presentation of better balanced rations both for adults and children. The objective representation of these four classes, the fats, the sugars and starches, the vegetable proteids, and the animal proteids, may for all practical purposes omit the consideration of calories and at the same time not lay too much emphasis on vitamins.

The family food supply has been gradually varied and menu building rendered easier by the promotion of home vegetable gardens, the growing of small fruits, a family canning budget, and the addition of sufficient cows to produce milk and butter for the family. The raising of the family's own meat and poultry has also contributed to needed family food supplies. The greater use of the food score card has brought out certain weaknesses in food preparation. Food preparation demonstrations and menu building have therefore been continued. The use of local leaders among adults as well as among boys' and girls' clubs has made possible the extending of many practical features of nutrition through various simple demonstrations. Local leaders have increased very rapidly in number during the year. The success of the plan has been due very largely to the more careful training of these local leaders by competent nutrition specialists.

REGIONAL REPORTS

The administrative work of the office, in its dealings with the States, is divided into four regions with a leader in charge of each region. During the year Miss F. E. Ward has continued in charge of the work in the Northeastern States, G. E. Farrell in the North Central States, and W. A. Lloyd in the Western States. As previously noted, O. B. Martin succeeded I. O. Schaub as regional leader in the Southern States in July, 1924. Important phases of the extension work in these regions are discussed in the paragraphs which follow.

Northeastern States.—The Northeastern States include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia.

The need for reducing the cost of production in dairying has stimulated

increased interest in the problem of weeding out low-producing cows through the regular type of cow-testing association. Particularly notable has been the increase in interest in better breeding by grading up the herds through the use of purebred dairy bulls. In Connecticut 450 purebred bulls were purchased by dairy farmers.

The problem of rising feed costs has led to increased interest in the work extension agents are carrying on to introduce more leguminous hay. Several States, notably New Hampshire, New York, and New Jersey, made an intensified effort to develop more interest in alfalfa.

The testing of cattle for tuberculosis and the eradication of tubercular cows has gone forward with greater interest and greater success than ever before. In many counties it has been the most important dairy project.

With the intensification of poultry husbandry in much of this section, disease has become a most important factor. Many of the disease problems are still in the research stage, but marked success has been won through the use of eggs from tested flocks as well as through the use of sanitary and preventive measures in raising chicks and caring for laying hens.

Interest in extension work in forestry has increased in the Northeastern States. Demonstrations in estimating woodlot timber have met with unusual success, especially in Maine.

The progress in home demonstration work has been marked, and fundamental problems of the home maker are being solved. Surveys and studies of the problems of the rural home have been made in a number of States in cooperation with the Bureau of Agricultural Economics and the Bureau of Home Economics.

There has been a tendency to simplify methods of work. For example, various units of a project are correlated, and the rural home maker who is able to attend but one meeting obtains something of practical help. The use of project leaders is increasing, and more attention is being given to the better training of such leaders.

Extension activities have included every phase of the clothing problem as it pertains to the women, girls, and little children in the farm home. In prosperous sections the selection of garments and materials has been stressed with a study of the clothing budget as a means of determining a

fair balance between expenditures for clothing and other items. In less well-to-do localities emphasis has been placed upon skillfully making over and renovating clothing to reduce expenditure. The major purposes of clothing work are the saving of time, material, effort, and money for the farm family and the enhancing of comfort and attractiveness.

Correlation of the work of the nutrition, garden, fruit, and dairy specialists in considering adequate diet for the family has been well worked out in certain of the States. In New York the orchard and vegetable garden specialists devoted considerable time to planning the garden budget and writing home-garden bulletins. With the dairy specialists they made possible a broad and practical program in human nutrition. This is an excellent example of team work between workers in agriculture and home economics.

North Central States.—The north central region includes Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Work in these States has continued along normal lines.

The total number of local leaders cooperating in the North Central States was increased from 74,262 in 1923 to 87,532 in 1924. The principal increase is due to the general adoption of the local leader method of carrying on home-demonstration work. More than 39,000 of the local leaders cooperating were women who helped to further extension work in home economics and girls' clubs.

There is a tendency in nearly all the North Central States to limit the number of projects worked upon in the counties and to encourage agents to concentrate on two or three major projects. The systematic use of agricultural campaigns is increasing, taking the form of "lime, legumes, livestock, and better living" in Kansas; "clover and prosperity campaigns" and "clover conferences" in Missouri; "dairy-alfalfa campaigns" in Michigan; "alfalfa campaigns" in Minnesota, Kentucky, and Nebraska; the "balanced agriculture" meetings in South Dakota; and the "seed corn culling campaigns" in Illinois.

The land-clearing work has been given special stimulus by making it possible for farmers to buy explosives from the Federal Government at cost of cartridge and freight. Nearly 6,000,000 pounds of pyrotol were distributed by this department to the

farmers of 10 of these States at the cost of cartridging and transportation.

One of the developments in county extension work during 1924 was the 4.7 per cent increase in the number of boys and girls completing club work. These States had 165,638 enrolled, with a total of 108,814, or 65 per cent, completing. There has been an increasing interest also, both among supervisors and agents, in getting at the facts through a careful analysis of agricultural statistics, reports, and other information which may indicate what projects should be emphasized and what methods are most effective in carrying on the work.

In the supervision of home-demonstration work during 1924 emphasis was placed upon training of the project leaders and keeping the public more fully informed in regard to the accomplishments in home-demonstration work. There was an increased correlation of the work of specialists, considering the interrelation, for example, of health with home management, clothing and nutrition projects; nutrition with health, gardening, and dairying; clothing with home management and art; and home management with agricultural engineering, food, and clothing.

Southern States.—The Southern States include Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

The most notable evidences of the progress of the extension work in the South in 1924 are found in the advanced nature of the demonstrations conducted by the farmers and the members of their families. Men and boys conducted 205,890 demonstrations in all lines of farm work, and 221,114 homes made exterior and interior improvements as object lessons in the progress of their enterprises.

The most significant crop demonstrations of the year were those in which winter and summer legumes were used with staple crops in soil building. Demonstrations with soybeans have greatly increased in number and size. In crop and soil demonstrations the closest cooperation is worked out with the experiment stations. For example, the farmers of Alabama follow the suggestions of the station so closely in cotton growing that they speak of it as the Auburn method.

The best boys' club work of the year was done with cotton. Practically every cotton State had one or more

counties where a club of boys averaged a bale of cotton per acre at low cost of production. Some of these clubs had more than 100 members each. These boys made about \$150 a year and did not neglect their school work. Some of them made more than \$300 per acre on cotton. The boys and girls also developed their group activities. Hundreds of camps of instruction and recreation have been held. Georgia built a \$30,000 encampment at the college of agriculture and many other substantial developments are taking place in other States.

Economic production and efficient marketing are progressing hand in hand. A typical example is found in Clarendon County, S. C. The business men and farmers organized a market bureau to sell the products resulting from diversified farming. All farmers were asked to bring in sweet potatoes on a certain date. It was necessary to buy potatoes with money from the bureau treasury in order to get enough to fill the first car. The returns from the shipment were so satisfactory that farmers later brought in enough to fill 31 more cars. They also sold \$100,000 worth of other products during the year. The agent says, "Every one of these farmers knows what No. 1, No. 2, and Jumbo potatoes are now."

Although the women and girls have devoted much attention to the equipment and improvement of kitchens, bedrooms, living rooms, and the home generally, they have not neglected their productive and income-earning enterprises. More than 100,000 of them made successful demonstrations in utilizing the products of the gardens and orchards. Their food preservation and conservation work has been excellent for a decade. Poultry demonstrations were conducted on 66,563 different farms. Home dairying was emphasized and 29,344 demonstrations were reported along this line. Some new things were done by the home demonstrators during the year. They made gloves, bags, and other high-grade leather articles from the hides, skins, and pelts on the farms. They also used such native material as honeysuckle vines, pine needles, white oak splits, and buckbush, and made standardized baskets for sale. In Mississippi alone \$12,000 were received for such baskets. Many women and girls have sold hundreds of dollars worth of flowers in addition to having plenty for use at home.

One of the greatest tributes to the work is found in the fact that local

boards increased appropriations for salaries and expenses of agents in many cases. In 1923 there were 1,809 agents, men and women, white and negro. This was an increase of 13 agents above the year before. This is a good showing in view of the fact that in many sections of the South the season was unfavorable and money was scarce. The prospects for the coming year are excellent.

Western States.—In this group are included the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. In the States composing the western division extension work had the same budget as for 1923. The legislatures in each of these States meet biennially, and 1924 was the second year of the biennium. The number of county agents and subject-matter specialists remained practically stationary. The number of supervisory leaders and the cost of administration were reduced, following the tendency of the past six years.

A widespread drought prevailing over much of the area, with a shortage of irrigation water due to insufficient snowfall in the mountains in the winter of 1923-24, seriously interfered with farming operations and also with demonstration work. The foot-and-mouth disease outbreak in California caused the stopping of demonstration meetings, both in farm and home demonstration work. Notwithstanding these interfering factors, the volume and quality of work was maintained.

The Western States extension program, development of which was begun in 1923 at the conference at Fort Collins, Colo., was further developed at the annual Western States extension conference at Tucson, Ariz., in the fall of 1924 by the adoption of permanent extension programs for the major farm crops—alfalfa, wheat, oats, barley, and potatoes. The regional program in human nutrition, livestock, and dairying was revised and definite goals fixed.

Much progress was made in the State fact organization work and the basis of State programs developed in Colorado, in addition to further intensification of the program in Oregon adopted last year. Washington, Montana, and Utah perfected organizations for the assembling of facts, and some work along this line was started in Nevada and New Mexico. These accomplishments are far-reaching and already are showing their influence in the better development of county ex-

tension programs. In Oregon the State program has been taken into the counties, and definite fact organization on a county basis has been carried on in 14 counties.

The better unification of all extension agencies on common extension objectives is the outstanding achievement of the year. Differentiation between lines of work or classes of workers has been largely neutralized. Almost every county agricultural agent in counties without home demonstration agents has projects including home economic phases, and with few exceptions county extension agents, both men and women, are paying increased attention to junior extension work as a means of demonstrating improved practices in agriculture and home economics.

DEMONSTRATIONS ON RECLAMATION PROJECTS

The office of demonstration on reclamation projects, previously administered by the Bureau of Plant Industry, was transferred to the Extension Service by the Secretary on August 16, 1924. The personnel and work of the office continued along the same lines as in previous years. This activity is under the general supervision of A. C. Cooley, with headquarters in Salt Lake City, Utah.

During the year definitely organized field work has been conducted on seven of the Federal projects, as follows: Newlands, Nev.; Minidoka, Idaho; Shoshone, Wyo.; Flathead, Mont.; Uncompahgre, Colo.; North Platte, Nebr.-Wyo.; and Belle Fourche, S. Dak. These projects have all had the services of a full-time demonstration man to assist them in the solution of their agricultural problems.

The annual conference of the demonstrators on reclamation projects was held at Fort Collins, Colo., May 25 and 26, 1925. The conference was attended by the director of extension work, the staff of the office of demonstrations on reclamation projects, and by several of the State directors of extension. One of the principal objects of the conference was to arrange for closer correlation between the office of demonstrations on reclamation projects and the extension services in the States in which the demonstrators are located. Plans were made for the taking over of the supervision of some of the demonstrators by the State directors of extension and for the assumption of office and field expenses by the States

and counties in which the demonstrators are located. It is expected that the department will continue to pay the full salary of these demonstrators and that the funds previously devoted to office and field expenses will be available for the placing of demonstrators on additional projects and for the employment of part-time men to give help to the settlers along such special lines as laying out their irrigation systems, preparation of land for irrigation, the raising of poultry, etc.

FIELD WORK

On each project where a representative of this office has been stationed, a program of work was outlined at the beginning of the year. In making up these programs effort has been made to select a few important activities needing attention and concentrate on them, rather than to undertake a general program covering the whole field of agriculture. The lines of work receiving the most attention during the year have been dairying, poultry, and sheep raising.

Dairying.—In dairying, herd improvement has been stressed. The purebred sire campaign which has now been under way for several years is showing encouraging results. The scrub sire is fast being replaced by the purebred and at the present time most dairy farmers either own or have access to a purebred bull. On some of the projects, especially the North Platte and Uncompahgre, the demonstration agents have worked out a plan whereby the purebred breeders lend promising young sires to farmers for testing. Under this plan the farmer obtaining a bull agrees to care for him properly and to keep accurate production records of his cows. Production records of heifers sired by the bull are also kept through their first lactation period. The breeders retain title to the bull and reserves the right to take him back whenever he has proved his worth as a sire. On a few of the projects the men have arranged with purebred breeders to accept scrub cows or bulls in exchange for purebred bull calves.

The record and testing work organized by the demonstration agents has resulted in eliminating a large number of poor producing cows from the herds and has increased the average annual butter-fat production per cow by several pounds.

The proper care of the cow, particularly feeding, has been given much

attention. Special emphasis has been put on preparing balanced rations from home-grown feeds, and the response of the farmers to it has been very good. Another phase of the feeding work has been the stimulation of interest in mixed-grass pastures. As a result grass pastures are becoming quite common on several projects. Considerable time has also been given to arranging and organizing for the tuberculin testing of cows. Some demonstrations have been given in treating animals for bloat, milk fever, and other minor ailments.

Poultry.—The attention of project farmers has been called to the need of giving the poultry industry more time and attention. Feeding, culling, and housing have been emphasized. The importance of good poultry houses and the right kind of feed for producing hens is not generally appreciated. The problem of getting a farmer to keep well-bred hens is very easy compared with getting him to care for them properly after he has them. The culling work has been very popular and during the season for it the services of the field men have been very much in demand. Assistance has also been given to many farmers in working out plans for new poultry houses and remodeling old ones.

The turkey industry has developed into one of importance on several of the projects. On the Newlands project in Nevada, for instance, more than 25,000 turkeys were raised last year, bringing in an income of \$100,000. Feeding and disease control have been the principal lines of work occupying the attention of the field men in helping this industry. One of the main channels for promoting the poultry industry has been through boys' and girls' clubs. Poultry clubs have been organized and definite instructions given the club members in the various phases of poultry production.

Sheep industry.—The high prices for wool and lambs the past two years, together with the relatively low prices for hogs, have created an unusual interest in the small farm flock of sheep. The number wanting sheep has been so great and prices so high that the demonstration men have discouraged many farmers rather than encouraged them to go into sheep raising. Nearly all of the projects have had a very noticeable increase in the number of small farm flocks. The demonstrators have been helpful to beginners in locating and selecting their sheep. As many of the projects are surrounded

by range, the raising of purebred rams for sale to large flock owners is developing into a very profitable business for project farmers. Lamb and wool pools have been encouraged and organized by several of the demonstration agents, resulting in the farmers receiving a better price for their product.

Swine industry.—The swine industry has not been very profitable on most projects the last few years. The long haul to market with relatively high prices for feed and low prices for pork has reduced the project hog population to the point where car-lot shipments to outside markets are very few compared with the number shipped a few years ago. Little encouragement has been given to the industry beyond local needs, and this has been largely through the boys' and girls' pig clubs.

Relationships.—The relationships between the office of demonstrations on reclamation projects and other Federal and State organizations doing similar work have been very cordial and helpful. Where representatives of this office and the State extension service cover the same territory, the work has been so organized as to eliminate duplication in every possible way. A very fine spirit of cooperation has existed between the workers and in many cases they occupy the same office. The Bureau of Reclamation has been very ready and willing at all times to help in every way in furthering the demonstration work. The splendid cooperation of the farm superintendents of the office of western irrigation agriculture of the Bureau of Plant Industry in furnishing the demonstration men with data and information of various kinds has been very helpful and is much appreciated.

EXHIBITS

ADMINISTRATION

Organization.—The office of exhibits continued during the year under the supervision of Joseph W. Hiscox. Instead of the six divisions previously reported, the work has been consolidated into three groups, with an officer in charge of each; (1) Administrative division, J. W. Hiscox; (2) Division of exhibit preparation, H. T. Baldwin; and (3) Division of exhibitions, C. A. Lindstrom. Under this new alignment all planning, designing, production, and engineering activities are placed under the officer in charge of the division of exhibit prepara-

tion. All matters relating to the conduct of exhibitions, preparation of publicity material, and the working out of agreements for financial and material cooperation from fairs and expositions, maintenance, warehousing, transportation, and installation are concentrated under the officer in charge of the division of exhibitions. All fiscal and business matters are conducted in the administrative division as heretofore.

Financial cooperation.—In order to reduce the large amount of accounting and to improve the efficiency in handling the exhibits special contributed funds, a change was effected April 1, 1925, by which all of these special deposits are placed in one fund without restricting their expenditures to the current fiscal year and carried under the title "Special Funds, Agricultural Fairs." Our experience in handling these special funds by fiscal years has demonstrated that this is entirely unnecessary, and only involves a useless amount of accounting. During the past fiscal year a total of 69 fairs and expositions made deposits with the disbursing officer of the department. These amounted to \$9,141.65, and were to cover transportation and installation costs. As in previous years the transportation cost was prorated and each fair and exposition asked to meet its share of the expense. Through the efforts of the department a considerable saving was effected in transportation costs to the 69 fairs and expositions which entered into this cooperative arrangement. Land-grant deductions and the securing of free return from transportation companies on a number of shipments made this possible.

The total amount spent from the department's regular appropriation for participation in State, interstate, and international fairs, for the fiscal year 1925, was approximately \$113,900. Adding the \$9,141.65 of contributed funds makes a total of approximately \$123,000 for all exhibits activities.

Discarded material.—On account of the crowded condition of our warehouse at Alexandria, Va., and lack of storage space, arrangements were made with the different bureaus and offices in the department to make a survey of the material stored at that point with a view to discarding all unserviceable articles. After a careful inspection had been made by the bureaus interested, a list of the discarded material was obtained, and a board of survey appointed which con-

demned the material as unserviceable. It was then disposed of at public auction in accordance with the property regulations of the department. These sales were held on March 21, March 31, May 1, May 8, and June 2, 1925. In all, 236 pieces of unserviceable material, comprising obsolete exhibits from the Bureau of Dairying, Bureau of Public Roads, and Forest Service, were sold. Before condemning this material, however, all of it which could be used in preparing new exhibits, such as lumber, compoboard, hardware, etc., was salvaged, as was such portions of it as could be used by the department's mechanical shops. Removal of these obsolete exhibits expedited the renovation of current exhibit material which was being delayed for lack of space to handle it. A large quantity of material which has been discarded by other bureaus is still on hand, which it is proposed to condemn and sell as soon as the rush of the current exhibit season is over and its disposition can be conveniently effected.

DIVISION OF EXHIBITS PREPARATION

During the fiscal year 66 new exhibits were completed, 27 were revised, 24 were renovated, and 15 new exhibits are under construction. The unit of measure is the standard booth exhibit.

The trend in design of exhibits has been in the direction of increasing their power to arouse interest and the rapidity with which the message is carried to the observer. Experience at fairs and expositions indicates that each year there is greater competition for the interest of the fair visitors from the standpoint both of the number of exhibits and their effectiveness in gaining attention. This means that more and more thought and ingenuity must be devoted to the planning and preparation of the department's educational exhibits in order that they may continue to gain and hold the attention of visitors and may tell their story quickly and strikingly. The type of exhibits prepared three or four years ago and then considered very successful would now be regarded as ineffective under the present conditions of increased competition. The preparation of the newer types of exhibits, which involve the use of many different methods of presentation, mechanical devices, lighting effects, etc., naturally requires more thought and labor and greater expense.

The need for newer and more effective exhibit methods has made it nec-

essary to investigate many new contrivances in the advertising and exhibit fields. The exhibit planners, therefore, have been on the lookout for new methods of presentation, mechanical aids, and improved materials for construction purposes. The new types of exhibits also presented many problems of an engineering nature and the exhibits engineer has investigated and adapted for our use a number of new materials and methods of construction. Plywood has been adopted as a substitute for wall boards of various kinds, in the preparation of cut-out figures of animals, people, and other objects. As plywood is less inclined to warp and has tougher edges, it requires very little bracing, previously a large factor in the cost of making cut-outs. Profile board, used for the bracing of stage scenery, was also adopted for use in exhibit building. The merits of this material, which is light and tough, were discovered by our engineer when investigating methods used by theatrical operators to produce realistic effects with materials of minimum weight and maximum strength.

A new type of exhibit structure called the universal booth was developed and two of these structures were built. As the sections of this exhibit are standardized they may be used either horizontally or vertically and are adapted for representing almost any type or shape of structure, especially exteriors and interiors of buildings where doors must be shown in the exhibit. The exhibit walls extend to the floor, making them more adaptable than the earlier exhibit structures, the lower part of which consisted of burlap curtains.

A second type of exhibit structure which was developed this year is so made that the framework folds into a small package, while the walls, which are muslin, can be rolled compactly. This type of exhibit is especially adapted to scenic effects. Eight of these exhibits were prepared for use this season.

Snap fasteners have been adopted for use wherever canvas backgrounds, burlap curtains, or other flexible materials are attached to exhibits. The snap fasteners reduce the time and labor required for setting up and taking down department exhibits at points of showings.

Another interesting development was the fireproofing of burlap curtains used in exhibit work. Curtains treated with fireproofing solution have not been ignited in the tests so far con-

ducted. Even if the curtains are not wholly fireproofed, at least their inflammability is greatly reduced—an important factor in exhibits.

Reports from fair circuits last year indicated that there was a need for a well organized information-publication booth on each circuit. Structures which were worked out for this purpose and which proved successful in field tests are to be added to the major exhibition circuits of fairs.

The number of visitors at the Washington headquarters from State extension forces, commercial concerns, and other agencies has greatly increased, compared with previous years, and to meet the demands for information from these sources it has been found necessary to keep one or more exhibits of each type in our work rooms. Blue prints of structural plans of these exhibit types have been sent out on request.

DIVISION OF EXHIBITIONS

During the past year the division of exhibitions has compiled complete descriptive summaries on the appearance, subject matter, and installation requirements of all exhibits. When distributed at fairs these summaries furnish valuable notes on the subject matter of the exhibits for visitors to take home with them. The summaries also give suggestions and information for the use of State extension workers. Detailed statistical records on the use of exhibits for information and study have been prepared.

The statistical studies which were started last winter, in connection with the annual check up of all exhibits material with the different bureaus to determine what material should be retained for further showing, brought out some rather striking information. Because of lack of space only a few of the more important points will be mentioned.

Participation by bureaus.—The study showed wide variation in the use which is being made of exhibits facilities by the various bureaus. In the period from July 1, 1921, to June 30, 1925, standard exhibit booths or their equivalent in scenic features were constructed for the bureaus as follows: Dairying, 72; Animal industry, 69; Agricultural Economics, 35; Public Roads, 20; Forest Service, 17; Home Economics, 16; Biological Survey, 8; Plant Industry, 7; Cooperative Extension, 7; Chemistry, 3; Weather, 1. The office of cooperative extension work, in addition to the 7 booths

portraying its activities, was responsible for initiating work on 30 booths listed as covering subject matter of the various bureaus. It is possible that some of the bureaus not now utilizing our exhibits facilities do not realize the scope and character of the work and the large number of people who view the department exhibits. During the fiscal year 1924, department exhibits at fairs were seen by more than 5,000,000 at comparatively small cost to the department. The figures show that the Bureau of Dairying and the Bureau of Animal Industry have been by far the largest users of the exhibit method of presenting their work. About two-thirds of the exhibits constructed during the past four years present the work of one or the other of these two bureaus.

Life of booth exhibits.—The factors affecting the life of exhibit booths—that is, the time during which they can be used effectively—are being studied. Among these factors are subject matter, method of presentation, timeliness of subject, area suitable for showing, and manner of construction. Of the booths constructed during the past four years, the following were considered still suitable for showing on June 30, 1924: Dairying, 36; Animal Industry, 50; Agricultural Economics, 12; Public Roads, 16; Forest Service, 16; Home Economics, 7; Biological Survey, 8; Plant Industry, 3; Cooperative Extension, 7; Chemistry, 3; Weather Bureau 1. Only half of the booths constructed on dairy subjects are still in use and only one-third of the Agricultural Economics booths, while 70 per cent of the Animal Industry, 80 per cent of the Public Roads, and 94 per cent of the Forest Service booths are being continued in service.

Exhibits made.—This year the number of exhibitions made has been cut down somewhat due to the curtailment, so far as possible, of showings at points other than State and interstate fairs. The application of the time and money thus saved to the improvement of exhibits for eligible fairs has resulted in the production of more attractive and well-made exhibits, as well as of more new material for these fairs. Also, the wear and tear on the exhibits has been substantially reduced, and the time and money usually spent for repairs has been lessened accordingly.

Following is a list of the points at which exhibits were made during the fiscal year, including the location, name of organization, and the dates of the showings:

List of exhibits displayed during the fiscal year ended June 30, 1925

Place	Occasion	Dates
Albany, Oreg.	Linn County Fair ¹	Sept. 17-20, 1924.
Ames, Iowa	College of Agriculture Short Course	Dec. 29, 1924-Jan. 3, 1925.
Atlantic City, N. J.	Highway Officials Association	Feb. 25-27, 1925.
Aurora, Ill.	Central States Exposition	Aug. 15-23, 1924.
Austin, Tex.	Texas State Exposition	Oct. 2-10, 1924.
Baker, Oreg.	Eastern Oregon Sportsman's Fair ¹	May 22-25, 1925.
Baltimore, Md.	Baltimore Poultry Show	Dec. 2-6, 1924.
Beaumont, Tex.	South Texas State Fair	Nov. 13-22, 1924.
Bel Alton, Md.	Charles County Fairs	Oct. 6-11, 1924.
Bethany, Mo.	North Missouri State Fair	Sept. 2-6, 1924.
Billings, Mont.	Midland Empire Fair	Sept. 16-29, 1924.
Charlotte, N. C.	Made-in-Carolinas Exposition	Sept. 23-Oct. 3, 1924.
Chicago, Ill.	Good Roads Congress	Jan. 5-9, 1925.
Do.	International Livestock Exposition ²	Nov. 29-Dec. 6, 1924.
Do.	Railway Show	Mar. 10-12, 1925.
Do.	Women's World Fair	Apr. 18-25, 1925.
Columbia, S. C.	South Carolina State Fair	Oct. 20-25, 1924.
Columbus, Ohio	Ohio State Fair ³	Aug. 24-30, 1924.
Do.	Southern Hotel	November, 1924.
Dallas, Tex.	Texas State Fair	Oct. 11-23, 1924.
Danville, Ill.	Illinois-Indiana Fair	Aug. 24-30, 1924.
Denver, Colo.	National Western Stock Show	Jan. 17-21, 1925.
Des Moines, Iowa	Iowa State Fair	Aug. 20-29, 1924.
Douglas, Wyo.	Wyoming State Fair	Sept. 16-29, 1924.
Fairfax Court House, Va.	Fairfax County Fair	Oct. 1-3, 1924.
Farmville, Va.	Cooperative Association of Virginia	Oct. 23-24, 1924.
Fort Worth, Tex.	Fat Stock Show	Mar. 8-15, 1925.
Fostoria, Ohio	National Farmers Exposition	Dec. 4-12, 1924.
Fresno, Calif.	Fresno District Fair	Sept. 29-Oct. 4, 1924.
Gainesville, Fla.	University of Florida	Feb. 11, 1925.
Kansas City, Mo.	American Royal Livestock Show	Nov. 17-22, 1924.
Do.	Kansas City Auto Show	Feb. 7-14, 1925.
Kingston, R. I.	Rhode Island Fairs	Sept. 11-27, 1924.
Lewiston, Idaho	Lewiston Fair	Sept. 9-13, 1924.
Lincoln, Nebr.	Nebraska State Fair	Aug. 31-Sept. 5, 1924.
Little Rock, Ark.	Arkansas State Fair	Oct. 6-11, 1924.
Los Angeles, Calif.	Conference Western Division, ¹ United States Chamber of Commerce.	Dec. 2-3, 1924.
Louisville, Ky.	Kentucky State Fair	Sept. 8-13, 1924.
Macon, Ga.	Georgia State Fair	Oct. 20-25, 1924.
Medford, Oreg.	Jackson County Fair ¹	Sept. 10-13, 1924.
Milwaukee, Wis.	National Dairy Exposition	Sept. 27-Oct. 4, 1924.
Missoula, Mont.	Western Montana Fair ¹	Sept. 30-Oct. 4, 1924.
Missouri and Arkansas	Missouri Pacific Marketing Train	Nov. 16, 1924-Jan. 16, 1925
Montgomery, Ala.	Alabama State Fair ²	Nov. 3-11, 1924.
Muskogee, Okla.	Oklahoma Free State Fair	Sept. 27-Oct. 4, 1924.
Nashville, Tenn.	Tennessee State Fair	Sept. 15-20, 1924.
New York	Southern Exposition	May 11-22, 1925.
New York State	Erie Railroad	November, 1924.
Phoenix, Ariz.	Arizona State Fair	Nov. 10-15, 1924.
Pomona, Calif.	Los Angeles County Fair ¹	Oct. 14-18, 1924.
Portland, Oreg.	Pacific International Livestock Exposition	Nov. 1-8, 1924.
Pueblo, Colo.	Colorado State Fair	Sept. 22-27, 1924.
Raleigh, N. C.	Negro State Fair	Oct. 20-26, 1924.
Do.	North Carolina State Fair ²	Oct. 13-18, 1924.
Richmond, Va.	Virginia State Fair ²	Oct. 6-11, 1924.
Riverside, Calif.	Southern California Fair	Oct. 7-12, 1924.
Rochester, N. Y.	Rochester Exposition	Sept. 1-6, 1924.
Rocky Point, R. I.	Rhode Island State Fair	Sept. 6-9, 1924.
Roseburg, Oreg.	Home Products Show ¹	Sept. 10-12, 1924.
Sacramento, Calif.	California State Fair	Aug. 30-Sept. 7, 1924.
St. Paul, Minn.	Minnesota State Fair	Aug. 30-Sept. 6, 1924.
Salt Lake City, Utah	Utah State Fair	Oct. 1-7, 1924.
San Bernardino, Calif.	National Orange Show	Feb. 19-Mar. 1, 1925.
Savannah, Ga.	Savannah Tri-State Fair	Oct. 27-Nov. 1, 1924.
Sedalia, Mo.	Missouri State Fair ³	Aug. 16-23, 1924.
Sioux City, Iowa	Interstate Fair	Sept. 14-20, 1924.
Spokane, Wash.	Spokane Interstate Fair	Sept. 1-6, 1924.
Springfield, Mass.	Eastern State Exposition	Sept. 14-20, 1924.
Springfield, Ill.	Illinois State Fair	Sept. 13-20, 1924.
Timonium, Md.	Maryland State Fair	Sept. 1-6, 1924.
Topeka, Kans.	Kansas Fairs	September and October, 1924.
Do.	Kansas Free Fair	Sept. 8-13, 1924.
Trenton, N. J.	Trenton Interstate Fair	Sept. 29-Oct. 4, 1924.
Urbana, Ill.	Farmers' Week, College of Agriculture	Jan. 12-17, 1925.
Ventura, Calif.	Ventura County Fair ¹	Oct. 1-5, 1924.
Waco, Tex.	Texas Cotton Palace ²	Oct. 25-Nov. 9, 1924.
Wallowa, Oreg.	Wallowa County Fair ¹	Sept. 29-Oct. 5, 1924.

¹ Exhibits made by Forest Service in West and reported to Washington.² These fairs had two separate exhibits.³ These fairs had three separate exhibits.

List of exhibits displayed during the fiscal year ended June 30, 1925—Continued

Place	Occasion	Dates
Washington, D. C.-----	American Association for Advancement of Science.	Dec. 30-31, 1924.
Do.-----	American Civic Association.....	Oct. 7-12, 1924.
Do.-----	Forestry Conference.....	Nov. 15-21, 1924.
Do.-----	International Council of Women.....	May 4-14, 1925.
Do.-----	National Food Show.....	Jan. 5-17, 1925.
Waterloo, Iowa.....	Dairy Cattle Congress.....	Sept. 22-28, 1924.
Wheeling, W. Va.....	West Virginia State Fair.....	Sept. 1-6, 1924.
Wichita Falls, Tex.....	Texas-Oklahoma Fair.....	Sept. 29-Oct. 5, 1924.
Yakima, Wash.....	Yakima Harvest Home Festival.....	Sept. 18-20, 1924.

¹ Exhibits made by Forest Service in West and reported to Washington.

Exhibits on western circuits.—Department of Agriculture exhibits were shown at State, interstate, and national fairs in the West through interbureau exhibit committees. This included showings in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, part of Texas, Utah, Washington, and Wyoming. The present western exhibit program was put into effect largely in compliance with the recommendations of Western States extension directors at their meeting in Fort Collins, Colo., in 1923. As a result, exhibits now fill the local needs of the State extension forces as well as present subject matter satisfactory to the bureaus.

The present plan of handling exhibits in the West has little more than got under way in the year and a half during which it has been in effect. As a result of experience so far, however, it appears that there will be genuine gain in efficiency and, therefore, in economy, through systematic organization and standardization. The net result of this efficiency and economy will be exhibits of better quality, which in turn will justify better cooperation from officials of fairs. These exhibits are serving their highest practical purpose in placing the cardinal principles of good agriculture before the general public.

Specifically, the department is accomplishing two ends in its present exhibit work in the West—first, education of the public in the general principles of good practice in agriculture and related pursuits, an admitted responsibility of the department; second, the establishment of cordial public relations with those by whom our service is appreciated.

MOTION PICTURES

The office of motion pictures continued during the year under the su-

pervision of Fred W. Perkins. Definite accomplishments during the fiscal year ended June 30, 1925, were as follows:

Completion of 28 new motion pictures of one or more reels, the total number of reels being 42.

Revision of 30 old films.

Beginning of scenario or production work, or both, on 25 new films.

Circulation of department films through extension workers and others to a partially reported audience of 2,902,242, and to a total audience believed to be in excess of 9,000,000.

Addition of 299 prints, totaling 419 reels, to the department's stock available for distribution, bringing the number of separate copies to 1,413 and the number of reels to 1,862.

Authorization of sale of 173 prints, totaling 257 reels, at a cost to purchasers of approximately \$9,000.

Improvement in quality of our films, and increase of circulation.

Invention of new apparatus for special work in motion-picture production.

Completion of manuscript for a circular on methods of using motion pictures by extension workers.

Increased results are shown in every important item subject to mathematical measurement, with the exception of sales of prints to authorized purchasers, which were 30 per cent below those of the preceding year.

Steady growth of circulation.—Particular encouragement is seen in the figures showing 2,902,242 people in the partially reported audience for our films during the year. As reports from many large users, including the numerous institutions that have purchased copies for their own use, have not been furnished, the estimated total audience of 9,000,000 people is believed to be conservative. The 9,000,000 represent every State in the Union, and practically every, important agricultural county. In the main they are farming people, residing largely in sparsely settled communities where moving visual demonstrations of improved agricultural practices may be expected to be most effective. These figures do not include the millions of

people in urban communities who have come in contact with the Department of Agriculture through the use of portions of department films in the film news weeklies, screen magazines, and other commercial productions of that nature. These would probably triple the estimated audience as given above.

That the beneficial results in spreading agricultural knowledge are comparable with the size of the audience is indicated by hundreds of expressions that have been received from users of our films. The county agricultural agent at Duncan, Ariz., reported, "The showing of moving pictures has done more to arouse interest in this county than any other one thing that I have tried." An extension specialist at the Illinois College of Agriculture writes, "Motion pictures are the most satisfactory means of bringing educational facts before people in country communities that we have tried so far." The home demonstration agent at Danbury, Conn., says, "I have used the films from the Department of Agriculture and found them quite satisfactory. I feel that we can do a great deal with pictures in our work."

With the continued purchase of projection apparatus by extension and farmers' organizations, the field for department films will continue to increase. An indication of the steady and fairly rapid growth is furnished by the fact that in the fiscal year 1925 the number of film shipments from the department laboratory was 4,260; in 1924, it was 3,199; in 1923, 2,175, and in 1922, 2,066.

New films completed.—The new motion picture films completed during the year number 28, representing an increase of two over the preceding year, and also representing, it is believed, a continuation of the steady improvement in quality that has won a wide reputation for the Department of Agriculture films. Numerous letters from users of department films indicate appreciation of the improved quality of the newer productions.

Following is a list of the new films completed and placed in distribution during the year:

The Green Barrier (two reels, Bureau of Animal Industry).

Sheep in Psalm and Sage (one reel, Bureau of Animal Industry).

Suppressing Foot-and-Mouth Disease (two reels, Bureau of Animal Industry).

Hog Breeds and Hog Management (one reel, Bureau of Animal Industry).

Weighed in the Balance (three reels, Bureau of Dairying).

Milk for You and Me (one-half reel, Bureau of Dairying).

Four Men and the Soy (two reels, Bureau of Plant Industry).

Why Strawberries Grow Whiskers (one reel, Bureau of Plant Industry).

Laying Lumbrius Low (one reel, Bureau of Plant Industry).

The Pines (two reels, Forest Service).

Pines—From Seed to Sawmill (two reels, Forest Service).

Pines for Profit (one reel, Forest Service).

Dual Purpose Trees (one reel, Forest Service).

Good Turns for Our Forests (one reel, Forest Service).

Beans or Beetles? (one reel, Bureau of Entomology).

Board Feet or Bored Timber (one reel, Bureau of Entomology).

Exploring the Upper Air (one reel, Weather Bureau).

Watching the Weather Above (two reels, Weather Bureau).

Cooperative Marketing—Cotton (two reels, Bureau of Agricultural Economics).

Cooperative Marketing—Tobacco (two reels, Bureau of Agricultural Economics).

Road Building in the United States (two reels, Bureau of Public Roads).

A Highway of Friendship (two reels, Bureau of Public Roads).

The Road Goes Through (one reel, Bureau of Public Roads).

Roads—From Surf to Summit (one reel, Bureau of Public Roads).

Across the Great Salt Desert (one reel, Bureau of Public Roads).

A Crop Worth Saving (two reels, Extension Service).

Touring With the Grangers (two reels, Extension Service).

Pan and Ceres in the Movies (one reel, Extension Service).

New films in preparation.—Films now in preparation, on which considerable preparatory or actual production work has been done, and most of which should be completed within the next few months, include the following:

Poor Mrs. Jones! (Extension Service.)
Traveling Extension Conference in California (Extension Service).

John Doe's Cotton—and Yours (Bureau of Plant Industry and Extension Service).

Magic In It (Bureau of Agricultural Economics).

The Horse and Man (Bureau of Animal Industry).

The Travels of a Banded Duck (Bureau of Biological Survey).

Back of the Weather Forecast (Weather Bureau).

Clouds (Weather Bureau).

Seed Inspection Work (Bureau of Plant Industry).

Uncle Sam's Forests (Forest Service).

Three other new forestry films (Forest Service).

Moth Control (Bureau of Entomology).

Japanese Beetle Control (Bureau of Entomology).

Alfalfa Weevil Control (Bureau of Entomology).

Dynamite on the Farm (Bureau of Public Roads).

Western Range Equipment (Bureau of Animal Industry).

Citrus By-Products Work (Bureau of Chemistry).

Bates Road Tests (Bureau of Public Roads).

Guard Rail Tests (Bureau of Public Roads).

Farm Terracing (Bureau of Public Roads).
 Farm Water Supply (Bureau of Public Roads).
 Turf (Bureau of Plant Industry).
 The Barnyard Underworld (Bureau of Animal Industry).

Cooperation with Government agencies.—

Without interference with its primary work, the office has been able to cooperate with other agencies of the Federal Government frequently during the past year. Assistance has been given to the Air Mail Service of the Post Office Department; the Geological Survey and the Bureau of Mines of the Department of the Interior; the Signal Corps and the Chemical Warfare Service of the War Department; the Public Health Service of the Treasury Department; the Bureau of Foreign and Domestic Commerce of the Department of Commerce; the State Department, and the Pan American Union. The office, in return, has received cooperation from most of these agencies, and from the National Museum.

Needs of the work.—A recent questionnaire sent to extension workers developed the fact that their main criticism of our film service is that they often can not get the film they want when they want it. Most of them naturally object to substitutions when their meetings are planned to cover certain subjects. One way of meeting this difficulty is for the department to supply more prints of its films for distribution from Washington. As many old prints are nearly worn out the need for this action becomes more pressing. Another way is for the State agricultural colleges and extension divisions to purchase more prints from our negatives. Many of these institutions are already large purchasers and are finding that circulation of films from a State center reduces the time and expense required in such distribution and gives closer contact with the local extension worker.

AGRICULTURAL INSTRUCTION

The office of agricultural instruction has continued under the supervision of E. H. Shinn. During the year Miss Edith Allen was transferred from the press service of the department. She will have charge of the editorial work of the office, the preparation of lantern slides for home economics teachers, and series of educational charts now being prepared in cooperation with other bureaus of the

department for the use of teachers of agriculture and nature study.

The work of the office consisted as heretofore of studies of methods of teaching and the content of subject matter for the use of agricultural teachers in secondary and elementary schools. Another phase of the work has been to make available to both teachers and pupils useful agricultural information accumulated by the Department of Agriculture and the State agricultural colleges and experiment stations. In these studies the aim has been to keep in as close contact as possible with the latest developments in agricultural education and to prepare the material in form for immediate use by teachers.

Interest in agricultural instruction in secondary and elementary schools continues to increase from year to year. Agriculture is now taught in approximately 3,000 high schools under the provisions of the Smith-Hughes Act, and in a large number of other high schools not receiving Federal aid. About two-thirds of the States now require that agriculture be taught in the elementary schools. The demand on the department for up-to-date material useful to teachers in these schools has increased each year. Only a limited number of teachers in elementary rural schools have had special training along agricultural lines. It has therefore been the aim of the office of agricultural instruction to give special attention to the needs of both teachers and pupils in this field.

By means of correspondence, visits to schools where agriculture is taught, and attendance at conferences and educational meetings, it has been possible to acquaint the teachers with much of the material of the Department of Agriculture that can be made available for their use. As a result of this contact, a wider use is being made of publications of the department classified by this office for the special use of teachers. Useful charts, prints, crop specimens and other material have been widely distributed. In order to render this service close cooperation has been maintained with the subject-matter specialists in the different bureaus of the department, who have willingly given valuable suggestions on material prepared. Agricultural teachers in the public schools look to the Department of Agriculture for a large amount of subject-matter material and suggestions on its use.

In supplying this material the department is performing a service which is not being duplicated by any other agency of the Government.

The demand from agricultural teachers for lantern slides adapted to their needs has rapidly increased. In the preparation and distribution of such material, close cooperation is maintained with the editorial and visual instruction section of the office of cooperative extension work and with specialists in the subjects in which the material is prepared. Lantern slide series were distributed during the year in 36 States, one State using as many as 42 series. About half of the circulation of department slides was to schools, 73 different series having been circulated. Series of slides are being revised from time to time as conditions require. New series are now in preparation calculated to show the best practices for teaching school garden work. To obtain the illustrations needed for the series on school garden work, cooperative arrangements were made with the supervisor and teachers of school garden and nature study in the city schools of Washington. Other series are being prepared on the control of household pests and on the fundamental principles of home economics. The illustrations to be used in the latter series were obtained in cooperation with the home economics teachers in the normal schools of Washington and the College of Education of the University of Maryland. Plans are now under way to prepare a series of slides for teachers of home economics in colored schools. The illustrations for the series will be taken in cooperation with colored teachers of home economics, some illustrations already having been made in cooperation with the home economics division of the Hampton Normal and Agricultural Institute.

In order to serve the agricultural education interests in a broad way it has been necessary to continue cooperation with agencies outside the Department of Agriculture. This cooperation is maintained (1) with States which desire to prepare courses of study in elementary agriculture for rural schools, (2) with the Federal Board for Vocational Education in making studies of analyses of certain farm enterprises, such as corn, cotton, poultry, etc., (3) with those in charge of teacher-training divisions of the agricultural colleges and normal schools, by furnishing lantern slide series and other illustrative material and by giving suggestions on

teaching procedure in studies of job analyses, and (4) with teachers in service by bringing to their attention results of studies in agricultural education made by members of the staff and sources of various kinds of useful material available for their needs.

In the matter of cooperating with States in preparing courses of study for teachers, the Oklahoma course was completed and submitted to the State Department of Education and the agricultural college for printing. The material for the Utah and Missouri courses is about completed and will be submitted for printing in the near future.

The cooperative relationship which has existed between the Federal Board for Vocational Education and the Department of Agriculture since the inception of the former has been continued on the same basis as heretofore. Under this arrangement, two studies were begun and completed during the year. The following publications were prepared by a member of the staff and published by the Federal board: (1) An Analysis of the Management of a Farm Business and (2) An Analysis of a Corn Growing Enterprise. In making these studies close cooperation was maintained with the subject-matter specialists of the Department of Agriculture, the purpose of these analyses being to determine the kind of training which the manager of a farm should have who desires to assume the responsibility of managing a farm business, or who may desire to engage in the corn-growing enterprise. The material included in these studies is based on extensive study and personal interviews with practical farmers in the field who are recognized for their skill and business ability in farming. Another study dealing with the analysis of a cotton enterprise is now being made under the same cooperation and will be completed during the year.

The nature of the service rendered in cooperation with teacher-training sections in the land-grant institutions has been along the following lines: (1) Supplying lantern slides and sources of other such material, (2) supplying prints of various kinds of illustrative material, and (3) conferences and suggestions on studies of the analyses of farm enterprises and teaching procedure. By means of this personal contact it has been possible for members of the staff to keep informed as to the latest developments in teacher-training work and to ob-

tain suggestions as to some of the important problems confronting the teacher-training group.

Cooperation with teachers in service constitutes an important part of the work of this office. Numerous requests come from teachers for suggestions on teaching agriculture. Two publications were prepared during the year for this group, one entitled "Lessons on Cotton for Elementary Rural Schools," and the other "Lessons on Corn for Elementary Schools." Lantern slides are widely distributed to teachers in service. Classified lists of publications of the department and sources of other material prepared for the special use of agricultural teachers were widely distributed. Educational series of charts on animals and crops are being prepared for distribution in cooperation with other bureaus of the department. Cooperation has been carried on as heretofore with the Bureau of Soils of the department in supplying teachers in service with sets of soil samples of the United States. These samples are sent only to schools which are teaching four-year courses in agriculture.

Members of the staff have attended the annual meeting of the National

Society for Vocational Education, regional conferences called by the Federal Board for Vocational Education, and State conferences of supervisors and teachers of vocational agriculture. By attending these conferences our agents are able to obtain from teachers much valuable information about the trend of development of vocational instruction and the best service possible to render teachers in this field. A member of the staff attended regional conferences on vocational education for negroes where problems relating to the training and supervision of teachers were discussed and plans formulated for improving the work. Members of the staff attended a conference on negro education called by the United States Commissioner of Education and attended by presidents of negro land-grant colleges and others interested in negro education. General problems relative to the curricula of the negro land-grant institutions were discussed and suggestions for improvement adopted. The office was also represented at the annual meeting of the National Education Association where an exhibit on phases of agricultural education was displayed before the division of rural education.



REPORT OF THE CHIEF OF THE OFFICE OF EXPERIMENT STATIONS

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., October 1, 1925.

SIR: I have the honor to submit herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1925.

E. W. ALLEN, *Chief.*

HON. WILLIAM M. JARDINE,
Secretary of Agriculture.

The work of the office centered, as in the past, in three principal lines of effort: The relations with the State agricultural experiment stations, including the promotion of research and the administration of the Federal funds granted in aid of these institutions; the management of experiment stations in the outlying possessions—Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands; and bibliographic work including the preparation of a current world review of agricultural investigations published in the abstract journal Experiment Station Record. In most of these lines the activities were similar to those in previous years.

Experiment stations have been in operation in all of the States under the terms of the Hatch Act of 1887, which provided \$15,000 to each State for financial aid, supplemented by the Adams Act of 1906, adding an equal amount at its maturity. During the fiscal year the State stations received therefore a total of \$1,440,000 from the Federal Treasury, which was supplemented by funds from State sources amounting to over five times that amount. This shows the liberal cooperative nature of the enterprise.

RELATIONS WITH THE STATIONS

Although the stations are State institutions, equipped, manned, and administered by the respective States, and for the most part departments of their agricultural colleges, the Federal Government has an important relation to them which is exercised

through the Office of Experiment Stations. The supervision of its contributions and the advisory functions which are exercised in regard to the research and management of the stations have led to enlarging the relationships to include the enterprise as a whole, and thus have resulted in close contacts with these institutions.

Each of the stations was visited by a representative of the office, the use to which the Federal funds were being devoted was determined, and the progress of work supported from other funds was also examined in considerable detail. Conferences were held on the policy of administration, development of resources, facilities, and methods, the lines of investigation calling especially for attention, and similar matters relating to the effectiveness and welfare of this important enterprise. The details of these activities are set forth in the annual report to Congress on the progress of the experiment stations.

In providing for agricultural investigation in the outlying possessions Congress has followed a different policy from that in case of the States, largely because of the difference in form of government. At the time the Hatch Act was passed there were no organized territories or other administrative units of the Government outside of continental United States: hence special provision has been made from time to time for experiment stations in these territorial areas, the direct management of which has been assigned to the Department of Agriculture and intrusted to this office. A

report on these stations is given on pages 4-13.

BIBLIOGRAPHIC WORK

The bibliographic work of the office has grown in importance with the volume and advance of agricultural research. It is an indispensable part of the activities, especially as responsibility has increased for the supervision of research efforts, to aid in making research effective by avoiding unwarranted duplication, and strengthening its attack. A revision of the list of projects of the experiment stations was prepared and issued during the year, classified by subjects to show the investigations in progress in every group of subjects receiving attention and where the work is being done. This comprehensive summary lists 5,538 projects, classified in 33 groups and 458 subdivisions. It is distributed among the experiment stations and throughout the bureaus of the department, and has found a useful application in the organization of new projects, the avoidance of repetition, and the promotion of cooperation and especially coordination. It serves to keep investigators informed of all work in progress, including such as has not been published upon.

The office maintains a complete file of the reports and bulletins issued by the agricultural experiment stations and the agricultural extension services of the States, primarily for the joint use of its own force and that of the Office of Cooperative Extension Work, as well as other bureaus of the department. It catalogues and files these so that they are readily available for reference, and it issues monthly a list of all these publications received currently. It also publishes a weekly list in the Official Record and a classified annual list in the report to Congress on the work and expenditures of the stations. In 1924 a list was published of all the bulletins issued by the experiment stations from their organization to the end of 1920, and during the past year a supplement to this list was issued, bringing it down through the calendar year 1922. (See also page 15.)

The largest piece of continuous bibliographic work is the preparation of abstracts of papers on agricultural investigation throughout the world for publication in Experiment Station Record. This is a very extensive undertaking, made possible by the exchanges and subscriptions of the department library. The librarians of this office assist in maintaining the

review by daily examination of all books, journals, and bulletins coming to the department library, to search out from this great mass of literature the accounts of investigation bearing on agriculture or the methods of inquiry relating to it in its varied branches. In this way the most comprehensive review in this field maintained by any agency in the world is kept current and published for the benefit of investigators, teachers, and others dependent upon such information. It is recognized as one of the Government's large contributions to the effectiveness of research and its application. A fuller report on the Record is given elsewhere (p. 13).

INCREASED FUNDS FOR RESEARCH

The culmination of the movement for increased appropriations for the State agricultural experiment stations was the most significant feature of the year. The steady growth in demands upon the stations and the lack of additional funds with which to meet these requirements in the face of the general increased costs had attracted attention for several years to the importance of further supplementing the Federal grants. This was crystallized in a report of the President's Agricultural Conference, which recommended the enactment of a bill already pending, but advising an increase in the amount of funds named in it. This bill, introduced and fostered by the Hon. Fred S. Purnell, of Indiana, was passed by Congress and signed by the President February 24, 1925, constituting the third measure for the maintenance of experiment stations in the States. It thus recognizes from a national point of view the satisfactory and profitable nature of this effort for the conduct of research, while the prompt acceptance of its provisions by all the States evidences the spirit of cooperation on their part.

The Purnell Act, like its predecessors, authorizes but does not carry appropriations. It provides for an increased grant to each State of \$20,000 for the fiscal year 1926, to be enlarged by \$10,000 annually until 1930, when the new fund will amount to \$60,000, this to be appropriated regularly thereafter. The necessary action to put the measure into effect was taken by Congress in authorizing the payment of \$960,000 to the States in the fiscal year beginning July 1, 1925, making with the amounts now paid under the Hatch and Adams Acts a fund of \$2,400,000 for experiment stations during the fiscal year 1926.

In addition to authorizing increased Federal support, the Purnell Act broadens the field the stations are definitely authorized to cover. In the past there has been some question as to the extent to which they were permitted to engage in researches in agricultural economics, home economics, and rural sociology, as these were not mentioned in previous legislation and are only in part experimental in method. The new act brings within the scope of the experiment stations experiments and investigations bearing on the production, distribution, and marketing of agricultural products, "and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life." It is therefore very comprehensive in character, and while it applies to everything previously included in the field of agricultural production it will of course stimulate investigation in the new lines mentioned.

In preparation for inaugurating plans under the Purnell Act a conference was called by the executive committee of the Association of Land-Grant Colleges, which met in St. Louis in April. This was attended by the presidents of the land-grant colleges, the directors of the experiment stations, the Secretary of Agriculture, the chief of this office, and a considerable number of other representatives of the department. It was a very important gathering, dominated by the spirit of cooperation and the determination to make the Purnell Act mark a new epoch in the efficiency of organized research for agriculture. There was full realization of the responsibilities which the new act carries, with its large prospective appropriations. The organization of research around projects of outstanding importance, either regional or national, was urged, and a larger measure of cooperative or coordinated effort was recognized as important at this stage.

Six national topics of considerable range were selected around which to organize cooperation, each being assigned to a committee of specialists for formulation. These committees met in Washington in June and outlined with considerable definiteness projects to be carried on in these subjects in cooperation with the Department of Agriculture. These plans were reviewed at a special meeting of the Joint Committee on Projects and Correlation of Research, representing the stations and the department, and

after their approval were published. The result is the joining by a large number of institutions in one or more of these national topics of research.

ENLARGED DUTIES OF THE OFFICE UNDER THE PURNELL ACT

The Purnell Act will very greatly enlarge the duties and responsibilities of the Office of Experiment Stations. Not only will this result from the supervision of the increased amount of Federal funds and the general enlargement of the station enterprise, but the determination of policy respecting the use of the new funds and especially the development of research in the newer lines will call for much study and detailed attention.

In accordance with the plan of administration determined upon, the Purnell fund will be expended on the basis of definite projects, expenditures being restricted to those connected with such projects. The money will therefore not be absorbed in the general maintenance funds of the stations, but will stand for definite projects, so that its use and results may be followed from year to year. These projects are to be submitted in advance for examination and approval before expenditures are made upon them.

This has proved a large undertaking, which the office has been required to carry with its regular force, as it had no additional funds with which to meet the situation. The new appropriation went into effect July 1, and during the late spring and the summer over 425 projects were submitted. Many of these, because of their nature, involved lengthy correspondence to develop their research character and determine their suitability to the fund. This required very careful definition of types of work entitled to be regarded as research, in a liberal interpretation, and the setting up of limitations between it and other kinds of activity. Many projects have required restating to bring out their research purpose and feasibility, while the strengthening of method has been a frequent necessity with others.

The carrying out of these requirements has proved an exacting and discriminating piece of work, with little that was definite to guide except the leading principles and considerations which apply to research in general. The attempt at constructive criticism and the raising of questions as to appropriateness and ways and means has, it is believed, directed

more serious thought to these matters, which has cleared the field to a notable extent and resulted in material improvement in the projects at the outset. Many proposals ultimately have been withdrawn or radically changed. It is maintained that the new work must be progressive, built on what has already been done, and that, while not of as advanced original character as that under the Adams fund, it must not be of the elementary type of earlier work.

The research programs are not yet complete for all the stations, waiting in part on obtaining the necessary personnel. Special attention has been given to holding the program within reasonable bounds, avoiding more new projects than could be adequately supported. When the number is large the statement of supplementary support from other sources is required.

The new fund will enlarge the relations of the office to cooperative undertakings. This is especially the case where cooperation between the department and the stations is concerned. It will require conference on cooperative proposals and projects, and a closer relationship to their progress than has existed in the past. After lines of study have been correlated and coordinated, attention will still be required to promote the work under them and hold the effort together in the interest of the common purpose. As a centralized agency, recognized as working for the welfare of the stations as a group and of research in general, the office is looked upon as the logical agency to exercise this type of leadership; and the Association of Land-Grant Colleges has urged the importance at this stage of enlarging the functions of the office so that it may not only supervise and advise but promote orderly research in channels where it is most needed. This naturally will require some additions to the force, with increased provision for travel and maintenance, but the amount will be trivial compared with the total funds involved. The present volume of this enterprise and its recognized importance fully warrant the necessary provision to procure cohesion and effective guidance.

DIVISION OF INSULAR STATIONS

The work of the agricultural experiment stations maintained by the department in Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands under the supervision of Walter H.

Evans, chief of the division, has continued along about the same lines as previously reported. These stations are endeavoring, through their investigations, to develop types of agriculture that are adapted to the conditions in their respective localities, and especially to diversify the agriculture in those countries where it has been developed very largely around a single industry. It is believed such a course will benefit all through a better citizenship. It has never been the policy of the stations to antagonize established industries, but they have tried to point the way to potential industries that might be taken up by those who do not desire or are unable to engage in the leading agricultural productions. The large, well-established industries can and are working out their problems in the territory served by the insular stations, but those wishing to engage in minor enterprises must come to the stations with their difficulties as there is usually no other source of information.

To properly carry on their work for the good of the greatest number the stations are inadequately supported. Their only income is that derived from appropriations made by Congress, and though there has been some adjustment in field salaries, their maintenance income has not been increased since the fiscal year 1920, although the cost of operation has increased steadily. This has necessitated the suspension of many projects, and at the same time there have been increasing demands for new investigations along various lines. In some cases the stations are equipped for the work but are lacking in the necessary personnel. In other instances both investigators and equipment are needed.

The income of every mainland agricultural experiment station was considerably increased by the recent action of Congress in approving the Purnell Act, but no provision was made for the insular stations, whose problems are as acute and along the same lines as those on the mainland. Questions of marketing minor agricultural products, home improvement, and rural sociology are all of great importance in the territories served by the insular stations, but these problems must be neglected along with many others that would probably serve to make a more stable and contented agricultural life. Every one of the insular stations needs an increase in its personnel to enable it to carry on important investigations and to

take the results of the work to the people for adoption. There is no other agency to perform this duty, and it should be properly supported.

The incomes of the various stations for the fiscal year ended June 30, 1925, were: Alaska, \$69,500; Hawaii, \$53,000; Porto Rico, \$50,000; Guam, \$15,000; and Virgin Islands, \$22,500. In addition, \$23,280 was appropriated to adjust the salaries of all the stations to make them as nearly as possible comparable with those in Washington, D. C., and a deficiency act of December 4, 1924, appropriated \$8,000 for the control of the coconut scale in Guam. During the past fiscal year the stations deposited in the Treasury as miscellaneous receipts \$6,342.37 derived from the sale of station products.

ALASKA STATIONS

Conditions in Alaska during the year were on the whole favorable for the work, although at all the interior stations there was a deficiency of rainfall in the early summer that resulted in short growth of all grains. At the Fairbanks station there was a frost-free period of 92 days, which is 9 days less than the average of the past 14 years. At the Matanuska station the frost-free period was 132 days, and many varieties of cereals ripened that would not have matured in a normal year. In the coast region the weather conditions were about normal.

Damage to cereals, clover, and alfalfa by rabbits at the interior stations at Fairbanks and Matanuska was so serious as to indicate the possible necessity of inclosing the experimental plats with rabbit-proof fences.

At the Sitka station, where horticultural work is featured, the work progressed very satisfactorily. The experiments in the production of new varieties of strawberries by hybridization and of potatoes through the growing of seedlings are among the leading investigations in progress. Since the publication of Bulletin 4, "Production of Improved Hardy Strawberries for Alaska," about 1,500 additional seedlings have been produced. Of the total number of seedlings grown at the station all but 268 have been rejected, and these are being given rigorous tests regarding their productiveness and the quality of the berries.

In the work with potatoes the station has tested about 75 commercial varieties and 1,200 seedlings. Of these all varieties that were unsatisfactory in yield or character of tuber have

been discarded and only about 50 varieties remain in the test. Among these are a number of the station varieties that show marked improvement over the standard varieties. They mature earlier and yield well, the tubers being large, smooth skinned, and of good shape and culinary quality.

The apple orchard has been reduced by the elimination of trees of all varieties that have not fruited. Of about 40 varieties that have been in this test, which was begun in 1903, only 5 have been retained for further use. Yellow Transparent has proved the most adaptable variety, and this is to be propagated for distribution to settlers. Similar reductions have been made in other plantings.

In an experiment in bulb growing, undertaken in cooperation with the Bureau of Plant Industry of this department, several thousand tulip and narcissus bulbs were planted at the station in the fall of 1923. They flowered well and the small bulbs which developed were set and appear to be growing very well. This experiment was undertaken to determine whether hardy-bulb growing can be made a minor industry in southeastern Alaska.

At the Matanuska station about 80 acres are in crops of all kinds, including areas on which grain and combinations of grain and leguminous plants are grown for feed. Plat tests were made of 30 varieties of wheat, 18 of barley, and 14 of oats during the past season, and calculated yields were obtained as follows: Wheat, 17 to 37 bushels per acre; barley, 15 to 39; and oats, 30 to 62 bushels. In field trials Siberian No. 1 wheat yielded 17.5 bushels, and Romanow, 17.6 bushels per acre. The barley yields were: Hull-less, 12; Hybrid No. 28, 14.6; and Hybrid No. 19, 20.8 bushels of grain per acre. Of the oats given field test for grain, Norwegian Black yielded 39 bushels per acre and La Conner, a white variety, 42 bushels. Among the root crops tested on a field scale the following yields were obtained: Potatoes, 353 bushels per acre; rutabagas, 520; mangels, 295; and field carrots, 200 bushels. These yields were obtained in a season when the early summer rains were deficient and the early growth of the crops was retarded by the lack of moisture.

The livestock at the Matanuska station consists of 13 head of Milking Shorthorn cattle, 3 work horses, and 9 sheep, the remnant of a flock attacked by dogs. Two of the young Shorthorn cows gave a daily average of 21 pounds

of milk for periods of 346 and 286 days, respectively. Two others gave each a daily average of 19 pounds during their first lactation period and were still in milk at the close of the year.

At the Fairbanks station about 64 acres were seeded to various grains and mixtures of grain and peas and grain and vetch for feed, and a large number of small plats were seeded with different varieties of grain and other crops to test their adaptability to Alaskan conditions. Yields were reduced by rabbit depredation. Wheat ranged in yield from 4 to 19 bushels per acre, while oats yielded 32 bushels and barley, 10 to 40 bushels.

In connection with wheat growing it was noted that yields were less following red clover, woolly vetch, and purple vetch than after a crop of potatoes. It seems probable that the green manure crops exhausted the soil moisture to such an extent in their growth and decomposition that there was not enough left for the wheat crop. The average rainfall for the five summer months is only 7.42 inches.

Among the livestock at the Fairbanks station are three yak-Galloway calves. The hybrids when born resemble Galloways, but as they grow older they show more of the yak characteristics.

In 1924 about 90 bushels of Petrowski turnips were grown at the Rampart station for seed production. This variety, an introduction of the station, is the most popular turnip in Alaska.

The Rampart, Fairbanks, and Matanuska stations have successfully developed strains of the garden pea, Alaska, that matures in the interior during a normal season. Interest was aroused in the possibilities of these strains for planting for canning purposes, and field tests were made during the past season in Wisconsin, Michigan, and New York. Though no important changes were noticed in earliness due to their production at high latitudes, the peas were found to be not inferior to commercial sources of seed, and when purified by roguing and further selection they may be of value for growing in some of the important pea-canning regions of the States.

It has been shown at the Kodiak station that Galloway cattle and some of the coarse-wool sheep are perfectly hardy and can survive the winters of southwestern Alaska with a minimum of feeding. Only a few of the Galloways were sold for breeding purposes,

the settlers apparently preferring a higher milk-yielding type of cattle. In 1916 an experiment was begun in crossing Galloways and Holsteins to develop a type of animal suited to the region having some of the hardness of the Galloway and at the same time giving a fair quantity of milk. The crosses obtained appear to be harder than the Holsteins and intermediate between the parents in milk production and fat content of the milk. The station now has 23 crossbred animals of various ages. All are polled, black, but smooth coated. It has been observed in stormy weather that the crossbred animals face the storm and go along with the Galloways, while the Holsteins hunt for shelter. Seven of the crossbred cows were in milk during the calendar year 1924. On a ration not much more than sufficient for maintenance and fed from 2 to 5 pounds of grain a day, two of the Holstein-Galloway cows gave 5,383 and 5,316 pounds of milk, and a Galloway-Holstein cross, 4,844 pounds. These are very fair yields when compared with those of the best purebred animals of the herd. The highest yielding Galloway cow gave 3,741 pounds of milk, and the best Holstein, 7,366 pounds. The average butterfat tests were Holsteins, 3.07; crossbreds, 3.8; and Galloways, 5.27 per cent.

The question yet to be solved for this region is that of winter feeds. Often haymaking is impossible on account of weather conditions, and recourse is had to silage. The station has depended to a large extent on native grasses cut along the beach and at heads of bays. This is expensive and not always sure. Experiments in growing silage plants are under way and will be extended as rapidly as cleared land is available.

A cabin of three rooms for laborers' quarters was erected at the Sitka station, and an implement shed and a silo at the Kodiak station were the principal structures erected. Electric-lighting plants of 2,000-watt capacity were added to the equipment of the Matanuska and Fairbanks stations. Motors were provided for the plants to furnish power for various purposes. The securing of these plants has greatly reduced the fire hazards at the stations, where formerly lanterns and kerosene lamps were exclusively used.

The Alaska stations are in need of additional funds to provide a modest office and residence building at the Fairbanks station to replace the log structure that is deteriorating rapidly.

At least 75 acres more land should be cleared at both the Matanuska and Fairbanks stations to permit of the establishment of a series of rotation fields and to provide feed and pasture for the increasing stock. The work has already shown that the maintenance of soil fertility is essential, and permanent fields for experiments along this line should be provided in the near future.

The only publication during the year was the Report of the Alaska Stations, 1923.

HAWAII STATION

The Hawaii station continued its investigation of problems connected with the production, marketing, conservation, and utilization of food and forage crops other than those constituting the leading agricultural industries of the islands. The problems of the sugar and pineapple industries are well cared for by these industries, but the grower of any other product has no agency other than the station to give him counsel and aid. The station has followed the policy of attempting to diversify the agriculture of Hawaii by indicating other crops that could be grown in case of necessity arising out of disaster or changed economic conditions. The importance of the situation was recognized recently by the Honolulu Chamber of Commerce in an indorsement of the development of minor industries to utilize local products and allay social unrest that is likely to develop where opportunities are limited to a few major industries.

Much attention has been given to the vegetative propagation of tropical fruit trees. This requires expert knowledge and special technique, but methods have been worked out that give satisfactory results with even the most difficult varieties. With the prevailing high prices demanded for grafted or budded trees or well-rooted cuttings of some varieties, very few are taking up fruit growing as a business. It is believed that by the adoption of the methods of the station supplies of improved varieties of planting material can soon be procured at reasonable cost. The question of seedling propagation of various tropical fruits and of the relative value of seedlings for stocks on which to graft improved varieties has been given attention. Sour-orange stock appeared to be better than rough lemon for the propagation of oranges and lemons in Hawaii and so-called native mangoes better for stock than

seedlings of the improved introduced varieties.

In hybridization work with the tomato and the papaya, several hundred seedlings were grown in an attempt to fix desirable characters in the tomato and to determine how far the fruit of one type of papaya may be influenced by the pollen of a tree of a different type.

The station collection of tropical fruits is being rapidly increased through introductions from other countries. Vigorous plants of a number of fruits hitherto not represented in Hawaii are growing, and some of them may be available for distribution in the near future.

Expert knowledge relating to tropical horticulture is not widely extended in Hawaii and much time has therefore to be given to extension work of various kinds. Clubs and schools visit the horticultural grounds and the children are made familiar with tropical plants and methods for their propagation. This creates a demand for new plants, and a large number were distributed during the year. Information as to the behavior of the plants under varying conditions is obtained and an interest is aroused in their growing.

A fixed strain of a hybrid between Henderson sweet corn and Guam corn that has the grain character of the sweet corn and the vigorous growth and leafhopper resistance of the Guam variety has been developed. An extensive experiment with dry-land taro has been begun. This plant, which furnishes an important food for the native population and others, is usually grown as a wet-land or submerged crop. The demand for areas suited to this crop and the high rentals charged are operating to decrease taro growing. Hawaiian dry-land taros, as well as a number from American Samoa, have been procured and the different varieties are under test on different soil types and water supplies. Sweet-potato breeding was continued, a large number of seedlings being grown, only a few of which were retained for further testing. Approximately 60,000 cuttings of station varieties were distributed during the year.

Considerable attention has been given to forage grasses, and the station surplus of Napier, Merker, Guatemala, and other grasses has been distributed to stockmen. By selection two distinct strains of Merker grass have been developed, one with thin stalks, the other with thick, rank-growing stems. In a comparative test

Guatemala grass has proved best for areas of limited rainfall. Several species of *Andropogon* were found to be more or less subject to the mosaic disease, and cooperative experiments are in progress with the Hawaiian Sugar Planters' Experiment Station to determine the possibility of the transmission of the disease through the seed.

The agronomist took part in various extension activities and advised regarding the diversified farming programs for the Hawaiian Homes Commission that is opening homesteads on Moikai for native Hawaiians. He also furnished improved planting material of a number of crops.

It is believed that satisfactory solutions of a number of technical problems relating to the growing of the edible canna and the extraction of the starch have been reached. A company has been formed at Hilo, Hawaii, that is engaged in the commercial manufacture of the starch, and the facilities of the factory as well as the fields of the company have been freely used in cooperative experiments. Cooperative work has been continued with local preserving companies on the standardization of jellies, marmalades, etc., from native fruits.

The investigation on the composition of Hawaiian and mainland vegetables was continued in part. This was the second season in which vegetables from the same lots of seed were grown in several localities in Hawaii and on the mainland, and although the experiment is not completed no warrant has been found for the common opinion that locally grown vegetables are deficient in iron and other mineral materials.

As already indicated, extension and demonstration work receives considerable attention by the station. There was marked activity during the year in the boys' and girls' club work, and an increase in the number of clubs and their enrollment is reported. Eighty-one standard clubs were maintained with an enrollment of 1,460 members. The vacation clubs organized early in the summer of 1924 proved so interesting and profitable that their continuance seems assured. The Honolulu Chamber of Commerce highly indorsed the work and it received the support of a number of other agencies. In connection with the Territorial Fair at Honolulu a garden club was organized and the members grew a large assortment of vegetables on a plot of land within the fair grounds. Canning clubs from Oahu and Maui gave demonstrations and made exhibits. Exhibits, contests

in stock judging, etc., were made at fairs on the other islands. This work is arousing much interest among the youth of the Territory.

On the island of Hawaii, the only one of the group to have an extension agent, various activities are in progress. Boys' and girls' clubs were organized in 12 schools during the year, and the preliminary work done for the establishment of 6 others. Exhibits were made by the members at the Hilo School Fair, the livestock section being especially well represented. The school gardens located in various parts of the island were repeatedly visited and advice was given on their specific problems.

In connection with the station's work on starch production from the edible canna, the extension agent started cooperative work with this crop in a large area not suited to the growing of sugar cane or other standard crops. The edible canna grows well in this region when protected from the strong winds. The extension agent has, therefore, urged the planting of windbreaks and aided in obtaining trees for that purpose. Through his efforts, pigeon pea growing has been established on the island of Hawaii, following its remarkable success on Maui. This crop, introduced by the station about 1907, is rapidly becoming an important crop in connection with stock raising and the maintenance of soil fertility.

The demonstration farm at Haleakala is proving a successful enterprise, and the Hawaiian Land Commission has permanently set aside the tract for the station's use. Forage crops, root crops, vegetables, and pineapples are receiving most attention to determine their behavior at the elevation of the farm, and success has been met with along most lines. The manager of the farm devised an implement for the ridging of the rows in pineapple fields, that is being widely adopted. As a result of the work with pineapples a neighboring rancher planted 50 acres to this crop in 1925.

The Hawaii station needs a larger force to enable it to carry on its investigations. An additional chemist is urgently needed and the extension work should be enlarged. The present staff can not carry on its investigations and at the same time give so much attention to extension work. The results of the extension work are beginning to be apparent, but another agent should be secured to further develop it.

The publications of the station during the year were: Bulletins 51, The

Guatemala avocado in Hawaii; 52. Manganese chlorosis of pineapples: Its cause and control; 53. The Hawaiian tree fern as a commercial source of starch; 54. Edible canna in Hawaii; Report of the Hawaii Agricultural Experiment Station, 1922; and Report of the Hawaii Agricultural Experiment Station, 1923.

PORTO RICO STATION

The work of the Porto Rico station continued very much as formerly. A new department, parasitology, was organized during the year and investigations on animal parasites were begun. With increased interest in livestock production the question of successfully combating parasites became of prime importance. The possibility of the local control of the cattle tick by dipping has been demonstrated and the station constructed the first dipping tank on the island in 1917. There are now about 200 public and private dipping vats that are extensively patronized, but as yet no island-wide campaign for eradication has been undertaken. Next in importance to the cattle tick is the liver fluke, *Fasciola hepatica*. This pest is apparently worse in the drier parts of the island where cattle have access to stagnant water. Lungworms, stomach worms, cattle hookworms, and nodular worms are also prevalent. An examination of the carcasses of 60 pigs slaughtered at a local abattoir showed 40 per cent to be infested with various nematoda and an equal number with the thorny-headed hog worm. A high degree of infestation with lungworms was also found. Dogs were found to be infested with the dog hookworm, and many also harbored roundworms, tapeworms, and coccidia. The work of Ackert on the rôle of pigs in the dissemination of the eggs of the human hookworm was confirmed.

The station dairy herd continues to show the possibilities of increasing milk production through the use of purebred sires and proper care. The possibility of breeding up a dairy herd from native stock by the use of purebred sires has been demonstrated. The three-quarter grade cows (Guernsey-native) of the station gave an average milk yield of 5,125 pounds during the year.

The early work of the station in procuring and distributing mosaic-resistant canes of the Japanese type was recognized by the presentation to it of a cup and memorial signed by 20 managers of sugar estates in the west-

ern part of the island. Canes of this type, although not affected by the mosaic disease, are not considered of the highest value, and the station is endeavoring to obtain better varieties through breeding experiments and the introduction of high-yielding immune or resistant varieties from other countries. Some such have been procured already, and they are being propagated for distribution as fast as possible. In the meantime it has been found that the thin types of cane can be planted much more closely than the standard varieties and the tonnage of cane and yield of sugar thereby very materially increased. Soaking the seed cane for three or four days in limewater before planting has been found to destroy borers in the stalks and to stimulate germination and early growth.

Drought is often a limiting factor in corn growing in some parts of the island. In preliminary experiments in breeding for drought resistance there was found to be a correlation between the thickness and the intensity of color of the leaves and the ability of the plants to withstand drought. This fact is being made use of in selecting seed corn.

The experiments with fertilizers for coffee continue to show the value of nitrogen and potash for this crop. The highest yields during the eight years the experiments have been in progress were from the plats which received nitrogen and potash but no phosphoric acid. Ammonium sulphate continues to prove a better source of nitrogen than nitrate of soda.

In the fertilizer experiments with bananas potash was found to increase fruit production, and one variety that is immune to wilt was found to have a potash content several times as great as the most susceptible variety. Experiments have been begun to determine whether wilt can be successfully combated by the use of potash fertilizers.

The coconut fertilizer experiments continue to give very erratic results.

A considerable number of mango trees of introduced varieties have come into bearing. The fruit of many of them is attacked by fruit flies and as a consequence would be subject to quarantine if shipped to the United States. Experiments have shown that both the green and ripe fruit may be canned and their original flavor and firmness retained. It is believed a small industry might thus be built up to care for the surplus fruit.

Experiments on the effect of length of day on plant growth were con-

tinued, three varieties of beans and two of sweet potatoes being under investigation. The growth under normal length of day and days artificially lengthened to correspond to the period of June illumination or shortened to that of December is being compared, and some striking differences have been noted.

The plant pathologist has definitely associated the coconut bud rot in Porto Rico with a species of *Phytophthora*. The period of incubation of the disease may vary from two to nine months, depending on weather and other conditions. Attempts to transmit the disease through infected nuts gave negative results. Cutting affected trees and burning the diseased crowns appeared to hold the rot in check.

Further investigation of the *Fusarium* disease of vanilla showed that the fungus spreads through the soil with great rapidity, readily attacks the aerial roots of vanilla, and quickly destroys the plants. No wilting of vanilla was observed as in the case of the banana wilt caused by *Fusarium cubense*.

A cotton disease, in which the leaves, bracts, and bolls are attacked by an undescribed species of *Helminthosporium*, is reported. A *Phytophthora* boll rot of cotton was recently found, the causal organism being morphologically similar to the species of *Phytophthora* associated with the coconut bud rot.

Tests of forage plants for various situations and uses were continued. For low moist ground Uba cane gave higher yields of green forage than either elephant grass or Guatemala grass. For higher land the grasses outyielded the cane. When cut at the proper stage all these forage plants can be fed with very small losses, as the stalks and leaves are readily eaten. Uba cane made good silage. Of the leguminous forage plants velvet beans have given the best results. They can be planted in cane stubble or in stands of elephant grass and Guatemala grass after cutting, and the combined forage fed to cattle.

Considerable progress is reported in working out some of the problems of pineapple growers. The results of studies of the soils and fertilizer requirements are being put into use by growers. The expert in charge of this work also acts as an advisor on matters pertaining to the citrus industry.

The Porto Rico station is in need of a research chemist and an animal husbandman. It has the equipment, and in view of the importance of some

of the problems needing study, it would appear to be good economy to add them to the staff.

The publications of the station during the year were: Bulletin 30, Coffee varieties in Porto Rico, and Report of the Porto Rico Agricultural Experiment Station, 1923.

GUAM STATION

Crop production in Guam was seriously interfered with by extreme weather conditions. A rainy season that culminated early in October, 1924, with a downpour at Agana of 19 inches in 15 hours and a total of 39.02 inches in 48 hours, was followed by the most pronounced drought the island has experienced for many years. As a result crops suffered, pastures were extremely short, and stock was reduced in condition.

An entomologist, S. R. Vandenberg, of the California Horticultural Commission, was added to the station staff during the year, and took up his new duties on March 22, 1925. The problem of immediate concern is the control of the coconut scale, but as there are so many plant pests to be investigated it is hoped the entomological service can be continued permanently. The European corn rootworm (*Pyrausta nubilalis*), the sugar cane borer (*Rhabdocnemis obscurus*), and the rice bug of India (*Leptocoris varicornis*), all introduced species, often cause serious losses of their host plants, and control measures are urgently needed. A severe outbreak of the coconut scale was discovered in the northern part of the island on December 29, 1923. Active measures for its control were begun at once by the station and the island authorities. The seriousness of the situation was presented to Congress, and a special appropriation was requested. Delay, due to a number of causes and inadequacy of the station funds to carry on the campaign that had been begun, made it necessary to suspend the control work. On December 6, 1924, however, a deficiency appropriation of \$8,000 was obtained from Congress, and the work was resumed as soon as possible. In the meantime the pest had spread over the greater part of the island. With the assurance that the work could be carried on, an entomologist was appointed and sent to Guam by the first available transportation. In the meantime a small insectary was erected, a considerable quantity of supplies was procured, and control measures were resumed. Although cleaning up and spraying had been resorted to in the

worst infested regions, it was believed that the most promising means of control would be natural enemies of the scale. With this idea in mind the entomologist took with him from California species of parasites that were known to prey on scale insects allied to the coconut scale. The first introductions were not unqualifiedly successful, but others are to be undertaken, and with the cooperation of the Bureau of Entomology of this department and the California Horticultural Commission it is hoped a number of parasitic and predacious insects can be introduced and established.

During the three months after his arrival the entomologist, with the cooperation of the insular patrol, made a survey of the situation. The infestation was found to be general over the northern half of the island, and the scale has also been found in many localities elsewhere, although not yet in great abundance. Three important natural enemies have been found attacking the scale in Guam. The most important is a small black ladybird identified as *Cryptogonus orbiculus nigripennis*. The others are two hymenopterous parasites that were bred out of scales, one the golden chalcid, *Aphelinus diaspidis*, and the other thought to be a form of *Aspidiotiphagus citrinus*, which attacks the male scales only. The black ladybird is widely distributed in the island, and it is believed that in conjunction with the campaign of cleaning, burning, and spraying begun a year ago the scale is being held in partial control. The beneficial insects will be aided in their development and multiplication, and others introduced, bred, and distributed as rapidly as possible. The remoteness of Guam from other centers of entomological work and the inadequate transportation facilities make the introduction of new species of beneficial insects a matter of great difficulty.

The entomologist found that in addition to the coconut the scale attacks breadfruit, papaya, banana, avocado, mango, guava, lemon, orange, cassava, coffee, tomatoes, eggplant and royal palm, all valuable economic plants, as well as many wild plants.

In order to overcome local prejudice relative to the feeding value of coconut meal, the station conducted a number of feeding tests with pigs in which locally produced coconut meal formed an important part of the ration. The cheapest gain was made by a lot of seven pigs which received coconut meal, mineral mixture, and Para grass pasture. These consumed an average

of 19.25 pounds of coconut meal daily for 80 days and made an average daily gain per pig of 0.803 pound at a cost of 2 cents per pound of gain. At the end of the test all the pigs were in good condition and no evil effect was noticeable. Other experiments showed larger gains, but they were made at a greatly increased cost. Where free access was given to corn and coconut meal the pigs ate more of the latter than is generally recommended. The experiments showed also that corn grown under usual local conditions is a very expensive feed for pigs.

A survey was made of a part of the island where the uplands are regularly burned over during the dry season with the idea of improving the pastures. It was found in many instances that unless rain fell very shortly after burning the pasture grasses were killed and troublesome or worthless weeds took their place. An effort is being made to induce the people to abandon this age-old practice.

The agronomy work has been mainly studies of the adaptability of introduced crops to Guam conditions.

Paspalum dilatatum again showed its ability to withstand drought. A planting of this grass, in which the plants were set at regular intervals of 18 inches apart, covered the ground completely in 90 days. Plantings made on thin soil overlying limestone, which is typical of much of the northern part of the island, showed Napier and Guatemala grasses to be best for the situation, with Merker, Pennisetum, and Japanese cane following in the order named.

Three varieties of alfalfa received from South Africa, sown with inoculation, made good growth and set seed. This is the first time the alfalfa plant has shown any indication of producing seed in Guam.

The first of a series of rotation experiments was completed during the year. Corn, cowpeas, and velvet beans were grown, usually two crops a year being produced, one in the dry and the other during the rainy season. Large increases of grain and forage were obtained for each of the rotated crops.

In the variety test of sweet potatoes grown during the rainy season the varieties introduced from the States proved much superior to the native sorts. The importance of trellis supports for yam vines was shown in largely increased yields of roots in nearly every variety, as a result of trellising.

The work with fruits and vegetables continued to be confined to tests of

varieties and strains adapted to local conditions, cultural treatment, methods of propagation, and the like. The station continued to distribute large quantities of seeds and plants for growing in home and school gardens and elsewhere.

Provision should be made for a larger staff for the Guam station and more adequate equipment. The director, for the past four years, has not only had to administer the station affairs but personally to plan and supervise the work in animal husbandry, agronomy, and horticulture. Work animals, implements, and tools are needed to do away with a large proportion of the hand labor that is now employed. The extension work, which was abandoned in 1921, should be revived, as it was shown to be the best means of reaching the native people.

The publications issued during the year were: Report of the Guam Agricultural Experiment Station, 1922, and Report of the Guam Agricultural Experiment Station, 1923.

VIRGIN ISLANDS STATION

The drought that had reduced agricultural production in the Virgin Islands during the last four years was broken by heavy rains in August, 1924, and following that time the rainfall was nearly normal. The increased precipitation for the year (56.13 inches) greatly stimulated agricultural production, which in turn improved labor conditions. The improved condition of pastures and the increased price of beef animals in Porto Rico have encouraged those engaged in cattle raising, the second largest industry of the islands. At the close of the fiscal year economic conditions on St. Croix were better than for several years past.

In order to furnish more adequate water supplies, the artificial reservoir that was constructed in 1924 was enlarged to a capacity of about 140,000 gallons. The galvanized-iron watershed was also enlarged to 15,000 square feet, and this catchment area now supplies water to cisterns of about 183,000 gallons capacity. It is estimated that a rainfall of about 20 inches will fill the cisterns, and as this is less than the minimum of recent years, it is believed the water situation is relieved for the present. Some repair work was done to the laborers' cottages.

Considerable interest in stock raising is being manifested in the islands, and the station is devoting as much attention to animal husbandry as its

resources will permit. Special efforts are being made to breed up the dairy herd, which consists of so-called native stock. The station now has a young purebred Milking Shorthorn bull, a high-grade Guernsey, and a grade Holstein bull. At the close of the fiscal year a purebred Guernsey bull calf and two heifers were purchased. On account of the presence of cattle ticks on St. Croix, the station has adopted the policy of buying young stock. Although this requires a longer time in which to build up a herd, there have been no losses from tick fever. Milk records are being kept of the station herd of native cows, with a view to selecting the most promising dams. Cows are being trained to two milkings a day, with hand feeding of calves, in place of the usual practice of one milking, the calves running with their dams through the day.

The station is also giving considerable attention to poultry raising. Trap-nest records of the station flock were made during the year. The best record for a so-called native fowl was 182 eggs in 358 days, and this hen was still laying at the close of the year. The vigor of the native stock is shown by the fact that out of a hatch of 30 chicks all were brought to maturity. The mongoose is a menace from the time of hatching until the fowls are half grown or more.

In 1924 the station procured from Porto Rico three 3-frame nuclei of Italian bees. Two of these were received in a weakened condition and were lost later. The other produced three colonies, from which 166 pounds of honey was taken during the year.

Work with field and horticultural crops received most attention by the station staff.

The station has in progress comparative tests of 48 varieties of sugar cane received from various countries. In order to protect St. Croix against the possibility of the introduction of diseases and insect pests a quarantine station has been established on St. Thomas, where cane is not produced commercially. After remaining in quarantine for several months the canes are grown on St. Croix and their value determined. In addition to the above varieties station seedlings of the 1922 and 1923 crops are being grown in the trial fields. In 1924 an experiment was begun to test the value of paper mulch as compared with the usual method of growing cane. Somewhat larger tonnage was obtained from the mulched plats, but the cost of the paper exceeded the

value of the increased yields. The effect on the ratoon crop is yet to be learned. Very favorable reports have been made of SC 12/4, a variety of cane originated at the station by the former director. Extensive trials of this cane have been made in Cuba and Porto Rico, where it yields well and is somewhat resistant to the mosaic disease and withstands drought and storms better than the common varieties grown.

Owing to the presence in St. Croix of the pink bollworm, no cotton was planted in 1923-24. In 1924-25 about 150 acres was planted to Sea Island cotton in St. Croix, but the returns were disappointing, due to the ravages of the bollworm. This is believed to indicate that the measures recommended for a closed season were not carried out over the whole area. At the station the seed cotton was fumigated each day as it was picked, and all old cotton plants destroyed. To date no trace has been seen of infestation of the plats. It is believed that with proper control through a closed season and attention to the seed the growing of cotton can be made profitable, even under pink-bollworm conditions. The station produced Sea Island seed cotton at the rate of 528 pounds per acre.

Sweet-potato improvement, through the production of seedling varieties, was continued along the lines reported last year. Of the more than 300 seedlings started in 1922 and 1923 many have been discarded and only those showing superior merit are continued. Four crop tests have been made of 112 varieties, and of these 7 have proved superior to the parent plants in yield in every test. Several others are proving of superior merit in other respects. A large number of seedlings produced in 1925 are being grown for further trial. It was found that when thoroughly fumigated roots were used for the production of draws and the draws were planted in noninfested soil, there was no evidence of the sweet-potato weevil.

In connection with its efforts to introduce minor crops that have a ready sale and are adapted to production in small units the station has given attention to the growing of Bermuda onions. Encouraged by the preliminary trials, a planting of one-half acre was made during the past year. The total yield was 12,000 pounds. Many were sold locally and others were shipped to St. Thomas, Porto Rico, and New York City, where they met with ready sale at an average price of 5 cents per pound. The average profit

was \$1.57 per bushel. Following the success of this shipment a Bermuda onion growers' association of 25 members was formed and 150 pounds of seed was purchased for fall planting.

The demonstration work begun on St. Thomas was temporarily checked by the loss of the land that had been granted to the station. Another tract was found and arrangements are pending to obtain it so that the work can be continued.

The Virgin Islands station is in need of additional funds to enable it to extend its demonstration work on St. Thomas and St. John and to engage an animal husbandman who can carry on work with livestock. Cattle raising is second in importance to sugar production and is capable of considerable extension, but there are problems relating to breeds, feeding, diseases, and other matters that need thorough study. The station can not undertake this with its present income and personnel.

The only publication issued during the year was: Report of the Virgin Islands Agricultural Experiment Station, 1923.

PUBLICATIONS OF THE OFFICE

The office contributed to the regular series of department publications during the year 40 documents aggregating 3,057 pages, as compared with 31 documents aggregating 2,577 pages the previous year. A considerable amount of material was also furnished for the use of the press service of the department, and several articles were published in outside journals.

EXPERIMENT STATION RECORD

Volumes 51 and 52 of Experiment Station Record were prepared for publication during the year, each consisting of the usual nine numbers and an index number. In accordance with well-established policies, these volumes consisted mainly of technical abstracts of the current scientific literature pertaining to agriculture, a total of 6,494 abstracts being included. About 10 per cent of the available 1,800 pages was devoted to the usual monthly editorials discussing the promotion of agricultural education and research and related questions, and to brief notes in each issue on progress in these directions in this and foreign countries.

The volume of literature to be abstracted increased materially. The output of publications from the experiment stations was considerably larger than ever before, and the pro-

portion of this material representing substantial investigations increased to an even greater extent. An unusual number of new journals for the publication of research were established, both in this country and abroad, and these still further increased the supply of material. As a result of these conditions the available space in the Record, which has not been increased since 1911, was taxed to the utmost, and the difficulties of obtaining prompt publication of abstracts were greatly augmented. Assuming that the existing policies are to be continued, an expansion of at least 200 pages of abstracts per year appears to be inevitable in the near future.

As the years go by the value of the Record as a permanent work of reference becomes correspondingly increased. Covering as it does a period essentially contemporaneous with that of the development of organized agricultural research, it is now the most complete compendium in existence of the findings of science as applied to agriculture. For this reason it has become well-nigh indispensable to investigators, as well as to teachers, extension workers, and others engaged in the promotion of agricultural education and research. There are many indications of the widespread recognition at home and abroad of the unique service which it has rendered and should continue to render along these lines.

Two useful bibliographical aids for users of the Record were completed during the year. The first of these is a list of abbreviations employed in the Record for titles of periodicals. This is a revision and enlargement of a similar list published in 1905 and covers the period 1915-1924. It includes abbreviations and full titles of periodicals, other than those of experiment station publications, from which abstracts are made for the Record. In the interest of consistency in making abbreviations for new periodicals there has been added a list of abbreviations of the principal words commonly used in the titles listed.

The rapid growth of the periodical literature making direct or indirect contributions to agricultural science is shown by the fact that whereas the list published in 1905 contained only 1,600 titles the present list contains about 3,600 titles in 15 or more languages. For the newer periodicals, fully 2,000 in number, there has hitherto been available to the reader of the Record no key to the abbreviated titles which have been employed. The

completion of this list will be of special service in this direction.

Various causes have delayed the completion of a general index to the Record since that appearing in 1913, but the manuscript for another volume is now in press, and it is expected that a restricted edition will ultimately be available for distribution. The new index will cover volumes 26 to 40, and although some economies and variations have been incorporated it will resemble its two predecessors in general arrangement and make-up.

The appearance of this general index is expected to prove of decided advantage in consulting the Record. Not only will it materially reduce the mechanical labor of a search through the 15 individual indexes which it will replace but its preparation has afforded an opportunity to improve the uniformity and consistency of the entries by bringing together under a common heading items previously separated by slight variations in wording.

Many requests have already been received for both these compilations, but despite the limited editions it is hoped to meet the needs of all libraries in which a reference set of the Record is maintained.

REPORTS ON THE WORK OF THE STATE STATIONS

Reports on the work and expenditures of the State agricultural experiment stations for 1922 and 1923 were issued. These reports deal as usual with the progress of the stations; special problems arising in connection with their administration; relations of the office with the stations; State legislation and appropriations affecting the stations; personnel, projects, and additions to equipment; some of the more important results of the year's work at the stations; a classified list of station publications issued during the year; and detailed statements of income and expenditures and other statistics. They contain also, as special features, reviews, with bibliographies, of station work on fat-soluble vitamins, fruit-bud formation, agricultural engineering, and range investigations in the report for 1922 and on infectious abortion, agricultural economics, and ventilation of animal shelters in the report for 1923. A similar report for 1924 was prepared and submitted for publication.

PUBLICATIONS OF THE INSULAR STATIONS

Publications of the experiment stations in Alaska and the insular possessions included 7 reports, 5 bulle-

tins, and 1 article in the Journal of Agricultural Research, as already noted. This is a substantial increase over the output of the previous year, but represents to some extent a clearing up of arrears in the publication work of these stations. Many of the investigations of the stations, however, have reached such a stage that they are yielding a steadily increasing output of valuable scientific and practical results.

OTHER PUBLICATIONS

It is becoming increasingly evident, as the volume and diversity of the work of the stations increase, that one of the most useful services the office performs in aid of agricultural research is in making more readily available information regarding scientific personnel and what has been done and is now in progress in the various lines of such research. The office is therefore enlarging its work in this direction as rapidly as its limited resources will permit.

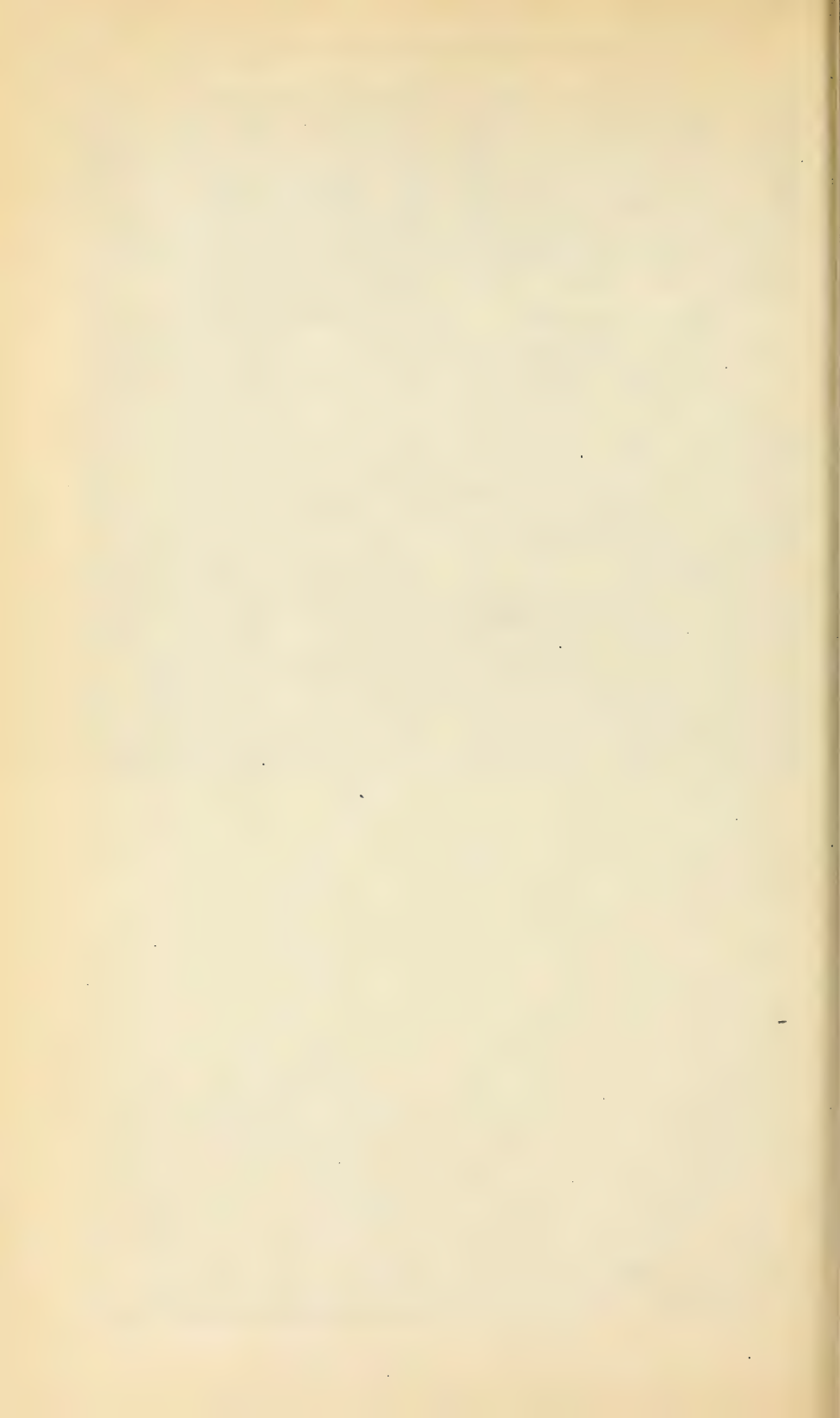
During the past year, without addition to its force, the office completed for publication, as already noted, a voluminous combined general index of volumes 26 to 40 of the Record, as well as a revised list of abbreviations and full titles of periodicals, other than those of experiment station publications, reviewed in the Record. It also published or prepared for publication 11 reviews, with bibliogra-

phies, of special subjects of station work.

The library of the office prepared an index of the proceedings of the Association of Land-Grant Colleges from 1885 to 1923, which was published in the Proceedings of the Association, 1924, pp. 110-141, thus making more readily available this important source of information regarding the history and development of agricultural research in this country.

The first of the series of biennial supplements to the list of bulletins of the experiment stations, covering the years 1921 and 1922 and including titles of 728 such bulletins, was issued, and a second supplement, covering the years 1923 and 1924 and including titles of 840 bulletins, with author and subject indexes, was prepared for publication. Weekly lists of station publications prepared by the office were published in the Official Record.

Revisions of the list of workers in agriculture and of the circular on Federal Legislation, Regulations, and Rulings Affecting Land-Grant Colleges and Experiment Stations were prepared and published. The first of these shows the main divisions of the work of the different institutions and the personnel employed in each. New features of the second, affecting especially the stations, are the text of the Purnell Act and a revised scheme of classification of expenditures of Federal funds for the experiment stations.



REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 29, 1925.

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1925.

Respectfully,

J. R. MOHLER,
Chief of Bureau.

Hon. WILLIAM M. JARDINE,
Secretary of Agriculture.

LIVESTOCK WORK OF NOTEWORTHY PROMINENCE

Three emergencies constituting a national menace to the livestock industry occurred during the fiscal year covered by this report. One was the continued presence in California of foot-and-mouth disease, which was discovered early in 1924. Another was the sudden appearance from a different source of the same disease in Texas. The third emergency was the outbreak and rapid spread of European fowl pest in a number of Eastern and Midwestern States. Besides meeting these special problems the Bureau of Animal Industry conducted its regular activities of a regulatory, experimental, research, and educational nature.

FOOT-AND-MOUTH DISEASE SUPPRESSED

In the work of eradicating foot-and-mouth disease, begun immediately after the infection was recognized in California, the inspection forces used the customary methods of quarantine, inspection, slaughter, disinfection, and payment of indemnities. The effectiveness of this system of dealing with this highly contagious malady was again demonstrated.

At the beginning of the fiscal year, July 1, 1924, the disease was still present in the counties of Los Angeles, Tuolumne, and Merced. Aggressive methods gradually reduced the infection, diseased herds frequently being slaughtered and buried on the same

day infection was found. In the counties mentioned the last appearance of cases of the disease among domestic livestock occurred August 23, October 9, and April 5, respectively. The testing and restocking of 702 infected premises showed that with but two exceptions the infection had been entirely destroyed by cleaning and disinfection—a high degree of effectiveness for these difficult operations.

The infection reached deer in the Stanislaus National Forest, and the task of eradicating so virulent a disease from wild deer in the mountains presented a new problem of great difficulty which was complicated by public sentiment for and against the destruction of such captivating creatures. A systematic campaign of hunting and poisoning deer in the infected area has apparently stamped out the disease, as no case of recent infection has been observed since June 10.

Before the California outbreak had been suppressed, foot-and-mouth disease also broke out in Texas late in September. Thorough investigation showed that infection in Texas probably entered through a Gulf port, there being no apparent connection with the outbreak in California. A force of inspectors was immediately sent to the infected region and in 30 days the last known diseased herd had been destroyed.

Further particulars and statistics of the work of suppressing these outbreaks of foot-and-mouth disease are given under the heading of Field Inspection Division.

INVASION AND SUPPRESSION OF EUROPEAN FOWL PEST

European fowl pest for the first time in history invaded the United States late in 1924. This disease, which spreads very quickly with deadly effect, broke out on the eastern seaboard, affecting especially Pennsylvania, New York, New Jersey, and Connecticut, and also invaded Indiana, Michigan, Missouri, Illinois, and West Virginia. In controlling and suppressing the malady the bureau used methods similar to those that had proved their value in combating foot-and-mouth disease. These efforts, which are reported more fully in connection with the work of the Field Inspection Division, finally brought the disease under control in May, 1925. In connection with the field work the bureau collected considerable data regarding fowl pest and is prepared to furnish information concerning its characteristics to veterinarians and others concerned.

Investigation to determine the source of the outbreak showed that a scientist working on filterable viruses in a large scientific institution had brought some of the virus of fowl pest into the United States from Europe for research purposes and had given samples to investigators in other institutions. It was also learned that a firm of poultry dealers in New York City regularly purchased birds from at least one of these institutions. Such incidents serve as a warning of the danger menacing our livestock industry from foreign plagues and show the need for constant vigilance to prevent the introduction of infection.

TUBERCULOSIS ERADICATION MAKES RAPID PROGRESS

Federal activity in eradicating tuberculosis of livestock received excellent cooperation from the various agencies concerned. States and counties increased the number of veterinarians engaged in this cooperative work, and combined State appropriations amounted to about \$7,000,000, or somewhat more than twice the Federal appropriation for the work. The increase in funds made possible a large increase in the number of cattle tested, which was about 32 per cent more than for the preceding year. Details of the progress of the work appear later in this report.

Outstanding results are as follows: Herds accredited as free from tuberculosis increased more than 24,000, bringing the total to 72,383. Of more than 7,000,000 cattle tested dur-

ing the year 3.1 per cent were condemned as diseased. This figure is a slight decline compared with former years. The eradication of tuberculosis from areas, usually counties, has demonstrated the value, efficiency, and economy of this method. At the end of the fiscal year 591 counties had either completed or were engaged in systematic tuberculosis eradication, an increase of 273 over the preceding year.

Because of the close relationship between tuberculosis of swine and fowls with the same disease in cattle, the bureau has conducted investigations aimed at the eventual eradication of the disease from all these classes of stock. A map showing the extent of bovine tuberculosis in the United States was published in the form of a poster, and the extent of fowl tuberculosis was also studied and mapped.

The suppression of tuberculosis from the livestock of the country has become a popular subject in the agricultural press and among farmers, as is shown by a wide discussion in farm papers and at rural meetings. A waiting list of 3,500,000 cattle at the end of the fiscal year shows the desire among cattle owners to have their herds tested.

SMALL LOSSES FROM HOG CHOLERA

The prevalence of hog cholera during the year was unusually low. Deaths from this disease were the lowest since records of losses have been kept. Experience shows that hog cholera has prevailed at periodical intervals, and charts based on past records indicated that numerous outbreaks were to be expected in 1925. Apparently the low ebb of the disease during the entire fiscal year is evidence of the effectiveness of the previous use of the preventive-serum treatment. This favorable condition, however, should not deceive hog raisers into a sense of security. The principal danger, judging from current knowledge of the disease, lies in the large proportion of swine that have not been immunized against cholera and therefore are susceptible to it. Should the disease begin to spread, losses probably would be extremely heavy before outbreaks could be brought under control. Extreme watchfulness therefore is urged in dealing with this treacherous malady.

SLIGHT DECLINE IN FEDERALLY INSPECTED SLAUGHTER

Compared with the unusually large number of food animals slaughtered under the Federal meat inspection in

previous fiscal years, the year just closed witnessed a slight decline. Approximately 76,000,000 animals, or nearly 4,000,000 less than in the preceding year, passed under the scrutiny of Federal inspectors. The slaughter, however, exceeded the average of recent years.

Judging by data of evidence showing the condition of farm animals on post-mortem inspection, tuberculosis in both cattle and swine continues to be the most widespread malady at time of slaughter. In fact, it was responsible for considerably more condemnations than all other diseases and ailments combined. These facts merit the attention of livestock producers and are further indication of the necessity for continuing the campaign of eradicating tuberculosis with the utmost vigor.

PROGRESS IN TICK ERADICATION

Active field work for the eradication of the ticks which cause Texas or tick fever of cattle was continued in cooperation with 10 Southern States. Georgia was released entirely from Federal quarantine following the eradication of ticks. Additional areas released from Federal quarantine included one or more counties in Arkansas, Florida, North Carolina, Oklahoma, and Texas. It was necessary to reguarantine areas in Alabama, Louisiana, and Texas, owing to the reappearance and spread of ticks in them. The dipping season of 1924 resulted in the complete eradication of ticks from 71 counties that were heavily infested the preceding year. More than 25,000 dipping vats, containing the customary arsenical solution, were in use. The bureau's inspectors continue to emphasize the importance of getting the last tick in areas which have been released from Federal quarantine but contain a few infested premises.

ECONOMY IN PRODUCING TUBERCULIN

Much of the work of technical divisions of the bureau, though yielding important results and giving promise of others to follow, is of a nature not suitable for discussion in a general report of this kind. The resourcefulness of scientific workers is well illustrated by labor-saving and time-saving devices established in one laboratory to increase the output of tuberculin. The methods used also lowered the cost materially. This detail brought about a saving of approximately \$11,000 in the manufacture of tuberculin for official use in the extensive testing

campaign already discussed. The output of this necessary product was 14,300,000 doses, a quantity which taxed the capacity of laboratory equipment.

STUDY OF WOOL AND OTHER ANIMAL FIBERS

Investigations of particular interest to wool growers are in progress at several of the bureau's experiment farms and at the wool laboratory on the bureau's farm at Beltsville, Md. One object of studies of fiber growth is to learn the rate of growth at different months and seasons of the year. Such practical knowledge, on which present information is extremely limited, promises to have wide significance. The experiments, when completed, are expected to establish the rate of growth for both wool and hair. Specialists of the bureau have developed several ingenious methods for making the measurements.

METHOD OF ROUNDWORM CONTROL WIDELY USED

A system of swine sanitation, mentioned in former reports, has gradually spread from McLean County, Ill., where bureau workers conducted early experiments, until the method is now widely used in hog-growing States. Extension workers in Iowa, Nebraska, and other States are active in acquainting swine growers with the method that has so greatly reduced losses caused by roundworms. Many swine growers are now raising as many pigs as formerly with about two-thirds as many brood sows. The McLean County system of swine sanitation, as the method is popularly termed, prevents death losses and runtiness almost entirely. These results show the practical application of scientific work which at its outset was extremely technical and involved a detailed study of the worm's life history and characteristics. Although control methods are now well established, the bureau is continuing its experiments with other parasites and related diseases. During the fiscal year the investigators used 9,000 pigs on 20 farms in such studies.

COOPERATIVE MEAT INVESTIGATIONS PLANNED

Following a series of meetings during the fiscal year, bureau representatives cooperating with State agricultural experiment stations, producers, and the meat trade developed plans for extensive meat investigations. The purpose of this branch of research is to obtain more detailed in-

formation concerning the quality, palatability, and food value of meat. Problems of production and distribution are also included in the proposed investigations.

OTHER IMPORTANT RESEARCH WORK

Research workers of the bureau have conducted investigations on a wide variety of problems. An important new study undertaken during the year was that of determining whether foot-and-mouth disease can be controlled or eradicated by any better method than the present plan of quarantine, slaughter, and disinfection of premises. As a safeguard to the livestock industry of the United States, research with this highly infectious disease is being conducted abroad, in localities where the malady is already present. Three scientists, one of whom is a Bureau of Animal Industry employee, and the others selected because of special qualifications, are working on the problem jointly, with headquarters at Strasbourg, France.

Investigations to learn definite causes of softness of pork and means of preventing this undesirable condition were continued in cooperation with numerous State experiment stations, particularly in the South, where the problem is most serious. Results obtained during the year appear in the report of work of the Animal Husbandry Division.

Investigations of the chemical principles of plants poisonous to livestock previously undertaken in connection with experimental field work have resulted in new knowledge on this subject. The toxic agent of loco weeds appears to represent an entirely new class of poisons. Studies of lupines, milkweeds, and other plants that cause stock poisoning have yielded results described more fully under the activities of the Pathological Division.

A method of producing immunity against tuberculosis is under test at the bureau's experiment station at Bethesda, Md., with preliminary results of an encouraging nature.

Other research studies deal with the mode of action of disinfectants, bovine infectious abortion, the vitamin content of meat and meat products, and tests of drugs to remove internal parasites of livestock.

SYSTEMATIC LIVESTOCK IMPROVEMENT CONTINUES

The fundamental importance of good livestock as a basis for an adequate supply of good-quality meat and

other animal products has been continually urged by the bureau in its efforts to promote livestock improvement. Under the "better sires—better stock" plan for extending the use of purebred sires about 1,500 livestock owners placed their breeding operations on a purebred-sire basis during the year. The total number of persons enrolled under this plan is nearly 16,000. This activity is conducted largely through county agents, who obtain from the bureau the necessary literature and educational material showing the utility value of improved livestock. At the end of the year there were 41 counties each having 100 or more farmers improving their stock under the plan mentioned.

The questionnaire study of farmers' experiences with purebred livestock disclosed new information of practical interest. Considerably more than half of purebred food animals, according to the data received, are marketed directly for meat purposes. Fully 96 per cent of livestock owners who have used purebred sires continue to use them and make their use general for all classes of livestock kept on the farm.

Farmers' reports on the cost of raising animals to maturity indicate that purebred meat animals for slaughter rather than for breeding cost slightly less to raise than scrubs, but purebred dairy cattle cost slightly more. This information, though necessarily only an approximation, should be considered in connection with the common knowledge that purebred livestock are worth very much more after they are raised.

According to the questionnaire replies, a larger percentage of male breeding stock eligible to registration is actually registered than of female stock. Taking the two sexes collectively it appears that only about half the purebreds are actually registered. The chief reasons for not registering purebred animals, as reported, are the intention to sell for slaughter, the lack of demand for registration papers when the stock is sold, and poor individuality.

PERSONNEL

At the beginning of the fiscal year the bureau rolls contained the names of 4,337 employees, including 60 departmental employees, mostly unskilled laborers on experiment farms, who were under the bureau's supervision. During the year 374 new appointments were made, 15 employees were transferred from other bureaus

or departments, and 31 former employees were reinstated, making a total of 420 additions to the bureau's forces. In the same period 718 employees were separated from the service, 117 by resignation, 26 by death, 191 by transfer to other branches of the Federal service, 7 by removal for cause, and 8 by retirement under the provisions of the act of May 22, 1920, while other separations numbered 369. At the close of the fiscal year the bureau's employees numbered 3,979. This number omits the 60 departmental employees mentioned above. This is a net decrease of 298. A considerable part of this decrease is accounted for by the reduction in the forces engaged in the eradication of foot-and-mouth disease in California and Texas and the transfer of 174 former bureau employees to the new Bureau of Dairying, which was established July 1, 1924.

VETERINARY EDUCATION

Two accredited veterinary colleges discontinued operations during the year, namely, the St. Joseph Veterinary College at St. Joseph, Mo., and the Indiana Veterinary College at Indianapolis, Ind. This leaves 13 veterinary colleges whose graduates are eligible to take civil-service examinations for positions in the bureau. Of the three agricultural colleges with two-year veterinary courses whose graduates are given credit for work completed in these institutions when entering an accredited veterinary college, two have discontinued their veterinary courses, leaving only one giving such a course. The number of foreign veterinary colleges accredited by the bureau remains at 10.

The total number of freshmen enrolled in all accredited veterinary colleges in the United States and the one in Canada for the school year 1924-25 as reported to the bureau was 163, as compared with 158 for the preceding year. The total student enrollment was 574, as compared with 571 for the preceding year. Graduates from accredited colleges in 1925 numbered 143, as compared with 160 in 1924.

LITERATURE, EXHIBITS, AND MOTION PICTURES

Publications prepared by the bureau during the year included 123 new and revised documents. The activities in coping with foot-and-mouth disease, European fowl pest, and other diseases already present in the country called for additional literature, in-

cluding several new posters. Contributions to the various series of publications included 38 farmers' bulletins, 8 department bulletins, 1 year-book paper, 13 issues of Service and Regulatory Announcements (including the index), 18 articles for the Journal of Agricultural Research, 2 department circulars, 5 miscellaneous pamphlets, and 31 orders of regulatory character. Seven posters and maps were planned and issued. The bureau also approved for publication in scientific, agricultural, and other periodicals 35 manuscripts prepared by its employees. The bureau furnished the press service of the department with articles, news material, and other items for publication to the number of 211, besides which 12 radio talks were prepared.

In cooperation with the Office of Exhibits of the department, bureau specialists designed and prepared exhibits and displays for expositions, shows, fairs, and meetings. The popularity of exhibit material on bureau activities has resulted in an increasing demand for this class of service. Small portable, folding exhibits proved to be specially useful for small fairs, for conventions, and in connection with addresses by field workers. These portable exhibits were sent to 57 points, and in many cases such points were distribution centers for the surrounding territory. Exhibit material made in the bureau was also shown at 11 prominent fairs and expositions.

The bureau has continued to cooperate with the department's Office of Motion Pictures in preparing scenarios and motion pictures. A revised film dealing with foot-and-mouth disease was prepared. New pictures relating to the bureau's activities are *The Green Barrier*, *Sheep in Psalm* and *Sage*, and *Man's Friend*, the *Horse*. Other new films are in course of preparation.

The series of available lantern slides, charts, and other pictorial matter has been increased.

REPORTS BY DIVISIONS

The year's work as conducted by the various divisions of the bureau is presented more fully in the following pages.

ANIMAL HUSBANDRY DIVISION

The work of the Animal Husbandry Division, consisting chiefly of research in animal husbandry, including poultry husbandry, was conducted under the direction of L. J. Cole, chief of the

division, until his resignation, effective September 9, 1924. For the remainder of the fiscal year the activities of the division were in charge of E. W. Sheets, who was appointed chief of the division October 16, 1924.

COOPERATIVE MEAT INVESTIGATIONS UNDERTAKEN

Much attention was given to the organization of a nation-wide study of the factors which influence the production and quality of meat, to be conducted in cooperation with State agricultural experiment stations and other agencies. Representatives of the division attended six meetings with State representatives, livestock producers, packers, wholesalers, and retailers, to lay plans for the study. The purpose of the investigation is to obtain fuller information concerning the quality, palatability, and food value of meat and on problems of meat production and distribution. Preliminary to this project, in order to provide a means for measuring the quality of meat, a machine has been designed for testing the tensile strength of meat fibers and another for measuring the force required to shear or break the fibers. Detailed directions for the slaughter, handling, measuring, cutting, and analyzing of the cattle and their carcasses to be used in the experiment have been formulated, and the literature of previous experimental work bearing on the problem has been reviewed.

ANIMAL HUSBANDRY EXTENSION

Cooperation with the department's Office of Cooperative Extension Work and State Agricultural colleges in animal husbandry extension work carried on under the provisions of the Smith-Lever Act was continued, with a view to getting information on animal husbandry subjects before the public extension agencies and into the practices of farmers. The division's activities in this project consisted in reviewing the plans for animal husbandry extension work from the various States and making recommendations for improvement, preparing for the Office of Cooperative Extension Work a summary of results from reports of State animal husbandry extension specialists, assisting in the preparation and utilization of literature, posters, lantern slides, motion pictures, exhibits, etc., attending conferences, and observing and aiding the field work of the agents.

ANIMAL HUSBANDRY EXPERIMENT FARM

The Animal Husbandry Experiment Farm at Beltsville, Md., was further developed as a practical laboratory for research in animal husbandry. Scientific studies and practical tests in breeding and feeding were conducted with beef cattle, hogs, sheep, poultry, and guinea pigs, with the aid of the laboratory and farm equipment with which the farm is provided. Arrangements were made for leasing 1,063½ acres of land adjoining the farm, for one year beginning July 1, 1925, as additional land was badly needed for pasture and the production of feed crops for the bureau's experimental animals.

ANIMAL NUTRITION

Investigations continued in the nutrition laboratory comprised the routine analysis of hog carcasses in connection with the cooperative investigations on soft pork, studies of the relation of age and the feed to character of fat deposited in hogs, and comparative investigations into the fats of other animals. The calorimeter laboratory was engaged in a study of the physical factors which influence the hatchability of eggs. A study is in progress to determine the protein requirements of laying hens and of chicks.

MEAT INVESTIGATIONS

Livestock and poultry were slaughtered in the abattoir at the Beltsville farm, and the resulting meat was sold, as shown in Table 1:

TABLE 1.—*Livestock and poultry slaughtered at Beltsville farm and meat sold*

Class	Number slaughtered	Meat sold
		<i>Pounds</i>
Cooperative soft-pork hogs....	393	62,811
Government-owned hogs.....	250	50,919
Government-owned sheep.....	212	6,591
Government-owned chickens..	1,890	6,010
Total.....	2,775	126,331

The market value of Government-owned hogs slaughtered averaged \$10.28 per 100 pounds. The sales from this meat returned the Government \$11.74 per 100 pounds live weight.

The hogs slaughtered averaged 211 pounds live weight. The averages for 1923 and 1924 were respectively 187 and 210 pounds. Dressing percentages averaged respectively 81.3, 80.2, and 79.1 per cent for those years.

A continuation of the study of the slaughter and cutting yields of hogs as classified by breed, sex, weight, live grades, and carcass grades does not include enough individuals to make the results authoritative. Records for this year, however, join closely with preceding work, none of them showing any particular difference in yield as regards the various breeds, sexes, and firmness of fat. A consistent difference in cutting yields between hogs in high and low condition has been found. Actual flesh and bone increases the percentage of ham and loin in thin hogs, whereas hogs in high flesh have produced proportionately higher yields of lard and heavy bacon.

Cured and smoked yields from heavy hams, bacon, and shoulders were found to be consistently higher than yields from lighter cuts cured in the same manner. Injecting brine into meat under pressure, called "pumping," increased the smoked yield of all cuts, but produced meat which is less favorably received by the consumers. Meat from soft and oily hogs continues to smoke at a loss in comparison with yields obtained with firm pork. Consumers have not discriminated against the soft hams but object seriously to the physical condition of soft bacon.

The use of sodium nitrite instead of nitrate in curing, the rate of penetration of brine as affected by its strength and the temperature, the influence of bacterial action in producing gray centers, and better ways for curing soft and oily meat were subjects of experiment on which it is too early to report. A study of the use of various oils, temperatures, and curing methods for the prevention of mold on stored smoked meat was continued.

Efforts were continued to discover a method which will enable the farmer to produce a safe and uniform cure even though he can not control the temperature. Experiments with low temperatures have been successful, more time in cure seeming to be the proper treatment. With temperatures ranging above 40° F., however, results have not been satisfactory. Meat cured with the formula and for the length of time which make it most palatable on smoking has not generally stood up through summer storage

so satisfactorily as the more heavily cured pieces. Smoked hams which the consumer calls too harsh and salty after smoking have mellowed and aged through storage and produced a more acceptable boiled product than the milder cures. It has been possible to oversalt, however, until even the aged ham was too harsh and salty to be palatable. It has not yet been found possible to cure bacon so that it may be stored through the summer without becoming strong unless so much salt is used as to destroy the desirable mild flavor which is sought in this product. Pure pork sausage has been stored successfully at a temperature between 34° and 38° F.

ANIMAL GENETICS

The inbreeding project with guinea pigs was continued, two of the families having reached the twenty-sixth generation of brother-sister mating. A year-by-year comparison of five inbred families for the period 1916-1924 has brought out clearly the consistency of family differences in such respects as weight at all ages and size of litter. A study of the mortality curves has revealed marked differentiation. A study of the mode of inheritance of differences in the number of hind toes is in progress and the study of the mode of inheritance of coat characters is being continued. The mathematical analysis of the conditions to be expected in a Mendelian population under inbreeding, selection, and assortative mating has been extended.

The inbreeding project with swine was also continued, one line having reached the second generation of brother-sister mating. The most outstanding result obtained from the first generation litters was the segregation of certain peculiar coat-color combinations.

Much of the work in animal genetics is too technical to be described in a report of this kind.

A research paper entitled "Corn and Hog Correlations" was published as Department Bulletin 1300.

BEEF-CATTLE INVESTIGATIONS

Investigations in the production, wintering, and fattening of beef cattle were conducted in the Appalachian region, in the Corn Belt, in the Cotton Belt, and in the range areas of the West, Northwest, and Southwest, in cooperation with the respective State agricultural experiment stations. The Bureau of Agricultural Economics, the Bureau of Plant Industry, and the

Forest Service of the department co-operated in some of these studies.

INVESTIGATIONS IN THE CORN BELT

Data on the feeding of more than 100,000 beef steers in the Corn Belt during the winters 1919-1923 have been prepared for publication. Progress reports have been issued each year on the work in each of the States of Illinois, Indiana, Iowa, Nebraska, and Missouri.

An experiment to determine relative values of different methods of feeding beef calves previous to weaning time was begun at the Sni-a-Bar Farms, Grain Valley, Mo., in May, 1925.

BEEF PRODUCTION ON THE RANGE

Investigations have been under way for three years in Texas and Colorado to determine the relative merits of various methods of producing range cattle. Progress reports have been published each year.

A survey of different practices of beef production in the northwestern range area, in Montana, North Dakota, South Dakota, Nebraska, and Wyoming, was begun in June, 1925, in cooperation with the respective State agricultural colleges.

Grazing experiments were conducted at Ardmore, S. Dak.

An experiment similar to that of previous years in wintering steers was carried on at Ardmore from November 6, 1924, to April 23, 1925, to determine the effects of various methods of winter feeding on the gains made on pasture during the following grazing season.

Three lots of calves were fed the same as during the preceding winter at the department's field stations at Big Spring, Tex., from November 25, 1924, to May 12, 1925, and at Tucumcari, N. Mex., from November 16, 1924, to June 18, 1925, to determine the relative values of home-grown feeds for fattening steers and the practicability of finishing cattle during the winter in those sections of the range area. Wintering rations for cows, yearling heifers, and calves were compared in experiments at Havre, the northern Montana substation.

A breeding herd of 180 beef cattle was established at the United States Range Livestock Experiment Station, Miles City, Mont., in the fall of 1924.

An experiment was carried on at Kingsville, Tex., from November 24, 1924, to May 23, 1925, in which Brahman crosses were compared with Hereford and Shorthorn steers in feed-lot performance and in killing

qualities. A progress report is being prepared for publication.

WINTERING STEERS IN THE APPALACHIAN REGION

An experiment begun in December, 1922, at Lewisburg, W. Va., was continued to study the growth of weanling calves, yearlings, and 2-year-old steers fed various winter rations followed by summer grazing on bluegrass pasture. Ninety head of Texas range-bred steers purchased as calves in the fall of 1922 are being used and will be marketed as 3-year-old grass-fat steers in the fall of 1925.

FEEDING BEEF CATTLE IN THE COTTON BELT

A project begun in March, 1923, on 320 acres of cut-over longleaf pine land at McNeill, Miss., was continued, to compare the effects of burning native pastures on the vegetation, the gains of cattle grazed thereon, and the reforestation which takes place. The work of improving the herd, begun in 1920 with native cows, is being continued.

The cooperative project with the Arkansas Agricultural Experiment Station and the State Agricultural and Mechanical College to compare the relation of feed consumed to the quantity and quality of meat produced by purebreds, grades with three-fourths and one-half pure blood, respectively, and scrubs, begun June 17, 1924, at Jonesboro, Ark., was continued.

At Jeanerette, La., an experiment comparing various rice by-products for fattening steers was carried on from October 28, 1924, to March 17, 1925.

SWINE INVESTIGATIONS

Swine investigations were continued at the bureau's experiment farm at Beltsville, Md., and at the several field stations, under the same projects as previously, maintaining co-operative relations with a number of State experiment stations.

FEEDER PIGS

Experiments in the production of feeder pigs were transferred from the station at Huntley, Mont., to the U. S. Range Livestock Experiment Station at Miles City, Mont. Feeder-pig studies were continued also at the Newell and Ardmore, S. Dak., stations. When weights approximating 100 pounds are reached the lots are divided, one lot at each station remain-

ing to be finished for market, the other to be shipped to cooperating experiment stations at St. Paul, Minn., and Lincoln, Nebr. All are finally slaughtered at convenient packing plants, where slaughter and shrinkage data are obtained.

SOFT-PORK INVESTIGATIONS

The investigations to determine the causes of softness and oiliness of pork, begun six years ago, were continued in cooperation with the State experiment stations of Alabama, Arkansas, Georgia, Indiana, Mississippi, North Carolina, Pennsylvania, South Carolina, and Tennessee. A discussion of the results of experiments and of the various problems related to the production of soft pork has been prepared for publication. Besides the results noted in that report, additional conclusions were adopted at a conference held at Atlanta, Ga., in May, 1925, as follows:

1. Peanuts grazed or self-fed in dry lot with or without minerals to pigs starting at weights ranging from 85 to 115 pounds and making gains of approximately 40 pounds or more on that feed through a period of approximately eight weeks will not produce firm carcasses at the usual market weight of from 200 to 225 pounds attained by subsequent feeding of corn with tankage after the peanuts.

Results have shown, in fact, that gain on corn with tankage up to about 120 pounds, this maximum being produced during a feeding period of approximately 16 weeks' duration, following gains of 40 pounds or more on peanuts, usually will not produce hard or medium-hard hogs. As the gain on peanuts increases, the subsequent gain on corn with tankage necessary to produce a certain degree of firmness likewise increases.

2. Soy beans grazed alone or with minerals self-fed to pigs starting at weights ranging from 85 to 160 pounds and making at least a moderate rate of gain through a period of from six to eight weeks will not produce firm carcasses in the usual case, even though a subsequent gain in weight has been made by the pigs on corn with tankage double that previously made on soy beans.

3. Soy beans grazed with a supplementary ration of 2½ per cent of shelled corn with or without minerals self-fed to pigs starting at weights ranging from 85 to 115 pounds and making gains of approximately 20 to 60 pounds through a period of from six to eight weeks will not produce firm carcasses in the usual case, even though a subsequent gain in weight has been made by the pigs on corn with tankage equal to that previously made on the soy bean plus 2½ per cent corn ration.

4. Soy beans grazed with a supplementary ration of 2½ per cent of shelled corn with or without minerals self-fed to pigs starting at weights of 115 pounds and over and making gains of approximately 40 to 90 pounds through a period of from six to eight weeks will produce firm carcasses in the usual case, provided a subsequent gain in weight is made on corn with tankage one and one-half times that previously made on the soy bean plus 2½ per cent corn ration.

5. Rice bran and tankage self-fed free choice on rye pasture or in dry lot and with or without a supplement of 5 pounds or less of skim milk per animal daily to pigs starting at weights under 100 pounds and making gains up to 100 pounds through a feeding period of from 8 to 16 weeks produce soft carcasses.

6. Rice polish and tankage self-fed free choice on oat or rye pasture or in dry lot to pigs starting at weights under 100 pounds and making gains of 35 pounds or more through a period of from five to eight weeks will not produce firm carcasses in the usual case, even though a subsequent gain in weight has been made by the pigs on corn with tankage equal to that previously made on the rice-polish ration.

OTHER WORK RELATING TO SWINE

Experiments with lice and worms of hogs, in cooperation with the Zoological Division, were continued. Studies of the effects of feed possessing varying deficiencies of vitamin on hogs and pigs and the continuing effect through successive generations, and studies on the effects of serum-virus treatment of suckling pigs of different ages were continued in cooperation with the Biochemic Division.

A cooperative project for studying the fecundity of swine, which has been in progress for several years at the Missouri Agricultural Experiment Station, was continued. Additional data corroborate former conclusions to the effect that sows bred first at from 6 to 10 months of age and twice a year thereafter, as compared with sows not bred until 16 or 18 months old, produce more pigs at less cost, and the pigs mature nearly, if not quite, as rapidly. Early breeding, together with generous feeding, however, results in slower growth of the sow.

SHEEP AND GOAT INVESTIGATIONS

FARM-SHEEP INVESTIGATIONS

Investigations relating to farm-sheep production were conducted at the United States Experiment Farm, Beltsville, Md.; the United States Morgan Horse Farm, Middlebury, Vt.; the Belle Fourche Experiment Farm, Newell, S. Dak.; the North Montana Substation, Havre, Mont.; and the Coastal Plain Experiment Station, McNeill, Miss.

Experiments at Beltsville, Md., consisted of (1) the development of a practical system of forage-crop pastures for sheep, (2) the effects of flushing (extra feed at the time of conception) on lamb yields, (3) growth studies of lambs and wool, and (4) type fixing of purebred sheep. The forage-crop studies have shown that sheep can be raised successfully by using forage crops to provide the

entire summer pasturage; that this method of producing lambs is beneficial in the control of stomach worms and other internal parasites which infest sheep and lambs; that by this method lambs can be grown to market weights without being visibly affected by parasite infestation; and that a frequent rotation of pasture made possible by this system is beneficial but not entirely adequate in the control of parasites in sheep carried throughout the year. The flushing experiment was conducted in a manner similar to that of previous years. The results of this year show an increase of 23 lambs per 100 ewes as a result of this practice. The growth studies include an intensive system of measuring the development of both bodies and fleeces of sheep with a view to determining the normal rate of growth and establishing the normal growth curve for sheep and wool. Type fixing of Southdown, Shropshire, Hampshire, and Corriedale sheep was continued by selective breeding, based on the bureau's detailed scoring system. The Beltsville flock on June 30, 1925, consisted of 358 sheep and lambs of the Southdown, Shropshire, Hampshire, and Corriedale breeds.

The studies of sheep at Middlebury, Vt., consisted of (1) the effects of flushing on lamb yields, (2) growth studies, (3) grading up farm sheep, and (4) the relative economy of early and late lamb production. The flushing experiment showed an increase of 17 lambs per 100 ewes as a result of extra feed at breeding time. Growth studies were conducted by means of weekly weighings of lambs and the measuring, weighing, and sample scouring of fleeces. Grading up was continued by the mating of first and second cross Southdown and Shropshire ewes to rams of their respective breeds, about 50 per cent of the best ewe lambs being retained for breeding purposes. The results from the experiment in the relative economy of early and late lamb production showed for the fifth consecutive year that late lambing is more profitable than early lambing under the conditions of pasture and climate that prevail in New England and the adjacent part of New York State. This year the net profit from the late lambing ewes was \$6 per ewe and for the early lambing ewes it was only \$1.95 per ewe. For the five-year period ended in November, 1924, the results of this experiment showed an average net

profit of \$5.47 per ewe for late lambing and only \$2.41 per ewe for early lambing. This difference of \$3.06 shows an average advantage of 127 per cent for the late lambs. On June 30 the flock at Middlebury consisted of 255 sheep and lambs.

At Newell, S. Dak., the sheep experiments included studies in the relative value of range ewes and purebred Hampshires for market lamb production and the usefulness of cull range ewes when handled under both irrigated and dry-land farm conditions. The Hampshire lambs made the most rapid gains, but the range ewes yielded the heaviest fleeces. It is encouraging to note the remarkable thrift of the sheep at Newell. That station is in the heart of an important sheep-producing region, and the results of the bureau's experiments there should have important and wide application. On June 30 the flock at Newell consisted of 124 sheep and lambs.

The sheep work at Havre, Mont., included a study of farm-flock maintenance under dry-farming conditions of the northern Great Plains. Both Shropshire and Rambouillet sheep were used for this work and they all did well. The ewe fleeces at Havre averaged more than 11 pounds. This is considerably greater than the average of any of the other flocks where the bureau is conducting farm-sheep investigations and approximately equal to the average for the bureau's range sheep at Miles City, Mont., and Dubois, Idaho. The Havre flock numbered about 100 sheep and lambs on June 30.

Studies in sheep raising at McNeill, Miss., continued to deal primarily with the problem of maintaining the breeding flock and raising lambs under the adverse conditions of a hot climate, coarse pastures, and parasitic infestation that prevail in the cut-over pine lands of the South. Results to date indicate that sheep raising under confined farm conditions is not profitable in that region. This year the mature ewes producing lambs yielded an average fleece weight of only 1.8 pounds and the mature wethers 2.8 pounds. During late winter and early spring the young lambs gained about one-quarter pound a day. By May they were gaining an average of only one-eighth pound a day and some of them were losing weight. On June 30 the McNeill flock numbered 20 sheep and lambs.

RANGE-SHEEP INVESTIGATIONS

The range-sheep investigations were conducted at the United States Sheep Experiment Station, Dubois, Idaho, and the United States Range Livestock Experiment Station, Miles City, Mont. Dubois is centrally situated in the intermountain region and Miles City is in the northern Great Plains. These are two distinct types of range country, and the conducting of range-sheep experiments at both stations does not constitute any actual duplication of work.

At Dubois, Idaho, the programs include (1) range utilization, (2) lamb production, (3) wool production, and (4) range-sheep breeding. All the work of this station is designed for broad application to the conditions of the intermountain region where the spring and fall grazing are on the intermediate sagebrush range, the summer grazing in the high mountains, and winter grazing in deep canyons and sheltered places. The investigations of range utilization include grazing studies in cooperation with the Forest Service and experiments in supplying stock with water on dry ranges. The drought of 1924 was extremely severe in the Dubois region so that grazing and watering results were considerably different from those of the preceding year, when rain was abundant. Such extreme changes in seasons make it necessary to conduct range experiments over periods of several years before drawing final conclusions.

A specific experiment on range lamb and wool production with a band of 1,200 ewes is in progress and the results of one year have been completed. Sheep of the Rambouillet, Corriedale, and Columbia breeds were used in special sheep-breeding experiments. At the close of the fiscal year the Dubois bands consisted of about 4,500 sheep and lambs.

Investigations with sheep at Miles City were begun this year. The project plan includes (1) range utilization, (2) lamb production, (3) wool production, and (4) sheep feeding. The band numbered about 1,400 sheep and lambs in June, 1925.

WOOL AND OTHER ANIMAL FIBERS

The work on wool and other animal fibers included (1) the determination of grease, dirt, and clean-wool content of fleeces from specially bred sheep, (2) methods of mixing wool to obtain uniform samples, (3) studies in the moisture content of wool, (4) studies

of wool-scouring processes, (5) measuring diameters of fibers of spinning count samples, (6) research on the growth of wool and hair, and (7) committee work on Government purchase specifications for curled hair to be used in mattresses, pillows, and upholstery. The laboratory work was conducted at the Beltsville Experiment Farm. Determinations of grease, dirt, and clean wool were made for about 1,500 fleeces. The various studies are yielding results of technical value.

MILK-GOAT INVESTIGATIONS

The work on breeding, feeding, and milk production with Toggenburg and Saanen goats was continued with good results in the accumulation of data and the improvement of stock. The herd at the Beltsville farm numbered 54 goats, including kids, at the close of the fiscal year.

HORSE AND MULE INVESTIGATIONS

BREEDING MORGAN HORSES

The breeding of Morgan horses was continued at the United States Morgan Horse Farm, Middlebury, Vt. The animals in this stud are used for obtaining research data relating to the production and use of light horses under New England conditions, including the study of various problems in the breeding, feeding, and management of light horses. At the Eastern States Exposition at Springfield, Mass., in September, 1924, the stallion Bennington was again champion Morgan stallion, and stock bred at this farm was given highest awards in numerous breeding, harness, and saddle classes. The demand for horses produced in this project continued to exceed the supply. Stallions from the farm stood for public service throughout New England.

A study of the problem of wintering idle brood mares, begun in 1909, was continued. Results show that such mares can be wintered economically and kept thrifty in open sheds. The best type of shed is one which opens on the southern side with hayrack along the inclosed northern side.

The feeding of silage to horses was also studied, in continuation of work in progress for several years. It has been definitely shown that corn silage is a safe feed for horses when not fed in excess of 10 pounds a day, provided frozen or moldy silage is not used. On the basis of these studies the following is considered a safe, practical, and economical daily ration

for idle brood mares in New England, where severe winters are the rule: Mixed hay of good quality, about 18 pounds; corn silage, 10 pounds; whole oats, 4 pounds.

Summarized breeding records for the years 1907 to 1924, inclusive, indicate that mares foaling during the colder months carry their foals beyond the average gestation period, while mares foaling during the warmer months deliver their foals a few days ahead of the average gestation period.

BREEDING AMERICAN UTILITY HORSES

The project for the development of a breed of native American utility horses for general farm and ranch work was continued in cooperation with the University of Wyoming at Laramie, Wyo. At the close of the fiscal year there were in the stud 40 animals, consisting of 8 stallions, 15 mature mares, four 2-year-old fillies, and 13 yearlings and weanlings. Glaisdale, an imported Thoroughbred, and Albion, a product of the project, are being used as the sires in the project. Six other stallions stood for public service in various sections of the range country. Reports indicate that these stallions are serving a very useful purpose in the improvement of the light-horse stock of the range country. The work of the station includes studies relative to the virility of breeding sires, feeding experiments under range and barn conditions, and the determination of salt requirements for horses on range pastures.

CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING PURPOSES

Under the provisions of paragraph 1506 of the tariff act of 1922 the bureau issued certificates of pure breeding for 1,426 cattle, 339 horses, 840 sheep, 21 swine, 1,666 dogs, and 14 cats, a total of 4,306 animals.

POULTRY INVESTIGATIONS

Poultry investigations were continued at the Beltsville farm, where the bureau has a well-equipped plant. Two summer laying houses were constructed during the year.

POULTRY BREEDING

About 6,500 chicks were hatched, the percentage of hatchable eggs being more than in any previous season. Since this, however, was but about 62 per cent, it is obvious that there is still room for considerable improvement, and efforts are being made in that direction.

The main breeding problem, which constitutes the study of the inheritance of egg production, progressed satisfactorily. Families have been established based on a large number of factors, such as egg production of the daughters and dams, hatchability of the eggs from the dams, viability of the chicks, and other characters. It will be several years before sufficient data are accumulated to make a conclusive analysis.

A project in inbreeding, extending previous work, was begun in the fall of 1924, with the primary object of studying the influence of inbreeding on constitutional vigor, egg production, hatchability, and other characters.

A paper was published in the Journal of Agricultural Research giving the results on the relationship between the shape and weight of eggs and sex of chicks hatched therefrom. It was found that there is no significant correlation between either shape or weight of egg and sex; therefore, from a practical standpoint, poultrymen could not hope to influence the sex of the flocks of chicks hatched by selecting eggs according to either shape or size. Another paper prepared for publication showed that the size of the egg has no significant effect on hatchability. Still another paper involves the study of the relationship between the weight of eggs and the weight of chicks by sex. The results show that from the practical standpoint it is highly improbable that chicks can be separated according to sex at hatching time.

Another experiment embraced a study of the influence of feeding desiccated thyroid gland on the development of secondary sexual characters in the chicken. It was found that such feeding caused certain changes from male to female characteristics, including changes in pigmentation of feathers, and also caused very rapid increase in the rate of growth of feathers, particularly in the more pronounced secondary sexual feathers.

An experiment to determine the cost of producing squabs was commenced and is being continued.

POULTRY NUTRITION AND FEEDING

A series of extensive experiments, to run for a year, were begun November 1, 1924, in an effort to determine the relative value of various amounts of protein in the ration of laying hens. Rations containing varying amounts of protein, but otherwise similar, are being used. Similar tests were also begun with chicks 2 weeks old, to determine the relative value of various

amounts of protein in the growth of chicks.

Another line of experimental feeding work, begun in the spring, includes testing the effect of various amounts of limestone on the structure and strength of eggshells.

Experiments are being conducted to determine on the one hand the relative difference in growth between males and females and on the other hand the relative influence of different constituents in the rations on such growth. It has been determined up to the present that males grow faster than females and that at as early as two weeks there is a significant difference between the sexes in the rate of growth. It was found also that the addition of skim milk to rations induced much faster growth, the difference being observable as early as at the end of the second week. This points to the value of skim milk in rations for growing chicks.

SOUTHWESTERN POULTRY INVESTIGATIONS

The work at the substation at Glendale, Ariz., was confined largely to feeding experiments (comparing different sources of protein in laying rations) and experiments in turkey raising. A number of experiments were conducted in the fattening of turkeys for market, in which it was demonstrated that the grains grown in the southwestern section of the country are quite suitable for fattening purposes.

MEAT INSPECTION DIVISION

The Federal meat inspection, conducted by the Meat Inspection Division, under R. P. Steddom, chief, shows a decrease of about 5 per cent in the total number of animals slaughtered as compared with the high record of the preceding year, though the slaughter was considerably above the average of recent years. The decline was principally in hogs. There was an increase in cattle and a slight decrease in sheep.

GENERAL MEAT INSPECTION

Inspection was conducted at 910 establishments engaged in interstate or export business, in 257 cities and towns, as compared with 916 establishments in 253 cities and towns during the fiscal year 1924. Inspection was inaugurated at 42 establishments and withdrawn from 44, as compared with 62 and 48, respectively, during the preceding year. Withdrawal of inspection from 43 establishments was

on account of the discontinuance of interstate business and from 1 on account of insanitary conditions.

ANTE-MORTEM AND POST-MORTEM INSPECTIONS

The ante-mortem and post-mortem inspections are given in Tables 2 and 3.

TABLE 2.—*Ante-mortem inspection of animals*

Class of animals	Passed	Suspected ¹	Condemned ²	Total animals
Cattle.....	9, 537, 596	236, 378	18	9, 773, 992
Calves.....	5, 168, 397	5, 384	34	5, 173, 815
Sheep.....	12, 202, 810	2, 542	6	12, 205, 358
Goats.....	26, 567	5	-----	26, 572
Swine.....	48, 645, 487	73, 835	1, 337	48, 720, 659
Horses.....	11, 909	-----	-----	11, 909
Total.....	75, 592, 766	318, 144	1, 395	75, 912, 305

¹ This term is used to designate animals suspected of being affected with any disease or condition that may cause condemnation in whole or in part on special post-mortem inspection.

² For additional condemnations see succeeding tables.

TABLE 3.—*Post-mortem inspection of animals*

Class of animals	Passed	Condemned	Total carcasses
Cattle.....	9, 681, 823	92, 055	9, 773, 883
Calves.....	5, 174, 228	11, 088	5, 185, 316
Sheep.....	12, 190, 458	12, 701	12, 203, 159
Goats.....	26, 456	114	26, 570
Swine.....	48, 279, 181	180, 427	48, 459, 608
Horses.....	11, 869	40	11, 909
Total.....	75, 364, 020	296, 425	75, 660, 445

Tables 4 and 5 show the diseases and conditions for which condemnations were made.

TABLE 4.—*Diseases and conditions for which condemnations were made on ante-mortem inspection*

Cause of condemnation	Cattle	Calves	Sheep	Swine
Abscess.....	-----	-----	-----	34
Congestion.....	-----	-----	-----	59
Emaciation.....	-----	-----	1	38
Hog cholera.....	-----	-----	-----	581
Immaturity.....	-----	24	-----	-----
Injuries.....	-----	-----	-----	6
Metritis.....	1	-----	-----	-----
Moribund.....	3	-----	-----	3
Phlebitis.....	-----	1	-----	-----
Pneumonia.....	1	2	2	26
Pyemia.....	-----	-----	1	1
Pyrexia.....	8	6	2	587
Septicemia.....	5	-----	-----	-----
Swine plague.....	-----	-----	-----	1
Tetanus.....	-----	1	-----	1
Total.....	18	34	6	1, 337

TABLE 5.—*Diseases and conditions for which condemnations were made on post-mortem inspection*

Cause of condemnation	Cattle		Calves		Sheep		Goats, carcasses	Swine		Horses	
	Carcasses	Parts	Carcasses	Parts	Carcasses	Parts		Carcasses	Parts	Carcasses	Parts
Actinomycosis.....	1, 097	97, 337	17	1, 770	-----	3	-----	2	6	-----	-----
Anthrax.....	-----	-----	-----	-----	-----	-----	-----	8	-----	-----	-----
Asphyxia.....	6	-----	6	-----	15	-----	-----	1, 260	-----	-----	-----
Blackleg.....	8	-----	11	-----	-----	-----	-----	-----	-----	-----	-----
Bone diseases.....	141	31	94	24	227	160	-----	8, 012	36	-----	-----
Caseous lymphadenitis.....	-----	-----	-----	-----	1, 165	10	1	-----	-----	-----	-----
Cellulitis.....	-----	-----	2	1	-----	-----	-----	32	229	-----	-----
Congestion.....	5	55	9	1	7	-----	-----	38	7	-----	-----
Contamination.....	9	2, 662	5	15	1	2	-----	1, 222	4, 268	-----	-----
Cysticercus.....	185	585	31	3	200	-----	1	103	1	-----	-----
Dropsical diseases.....	12	-----	1	-----	4	-----	-----	2	1	-----	-----
Emaciation.....	7, 010	-----	2, 059	-----	3, 040	88	-----	1, 169	3	-----	-----
Frozen.....	-----	-----	-----	-----	-----	-----	-----	1	-----	-----	-----
Gangrene.....	75	-----	40	-----	3	-----	-----	8	-----	-----	-----
Hog cholera.....	-----	-----	-----	-----	-----	-----	-----	19, 001	-----	-----	-----
Hydronephrosis.....	-----	-----	-----	-----	1	-----	-----	42	1	-----	-----
Icterus.....	104	-----	152	-----	1, 329	-----	1	4, 397	-----	1	-----
Immaturity.....	-----	-----	3, 629	-----	-----	-----	-----	-----	-----	-----	-----
Injuries, bruises, etc.....	6, 666	454	1, 048	118	678	181	5	1, 277	5, 814	-----	-----
Leukemia.....	559	-----	28	-----	8	-----	1	194	-----	-----	-----
Melanosis.....	31	8	92	7	21	-----	-----	101	3	1	-----
Moribund.....	21	-----	3	-----	46	-----	-----	109	-----	-----	-----
Necrobacillosis.....	4	-----	1	-----	2	1	-----	-----	1	-----	-----
Necrosis.....	2	1, 377	-----	-----	-----	-----	-----	3	-----	-----	-----
Parasitic diseases.....	14	51	-----	1	9	-----	-----	57	-----	-----	-----
Phlebitis.....	-----	-----	63	-----	-----	-----	-----	-----	-----	-----	-----
Pneumonia, peritonitis, enteritis metritis, pleurisy, etc.....	8, 663	-----	1, 964	-----	4, 738	-----	5	26, 211	-----	13	-----
Pregnancy and recent parturition.....	127	-----	-----	-----	19	-----	-----	42	-----	-----	-----
Septicæmia, pyæmia, uremia, etc.....	4, 595	-----	980	-----	1, 047	6	-----	23, 841	-----	15	-----
Sexual odor.....	3	-----	-----	-----	1	5	-----	3, 535	-----	-----	-----
Skin diseases.....	-----	-----	4	-----	1	-----	-----	100	-----	-----	-----
Swine plague.....	-----	-----	-----	-----	-----	-----	-----	12	-----	-----	-----
Texas fever.....	54	-----	100	-----	-----	-----	-----	-----	-----	-----	-----
Tuberculosis.....	61, 104	84, 027	708	571	-----	-----	-----	86, 282	939, 294	-----	-----
Tumors and abscesses.....	1, 560	2, 994	41	326	140	39	1	3, 366	152, 146	6	1
Total.....	92, 055	189, 581	11, 088	2, 837	12, 701	396	114	180, 427	1, 101, 806	40	1

Table 6 shows the total condemnations on ante-mortem and post-mortem inspections combined.

TABLE 6.—*Summary of condemnations*

Class of animals	Animals or carcasses	Parts
Cattle.....	92, 073	189, 581
Calves.....	11, 122	2, 837
Sheep.....	12, 707	396
Goats.....	114	-----
Swine.....	181, 764	1, 101, 806
Horses.....	40	1
Total.....	297, 820	1, 294, 621

In addition the carcasses of 65,394 animals found dead or in a dying condition were tanked, as follows: Cattle, 4,635; calves, 4,206; sheep, 9,565; goats, 83; swine, 46,904; horses, 1.

INSPECTION OF MEAT AND PRODUCTS

The inspection and supervision of meat and products prepared and

processed are shown in Table 7, which is a record only of inspection performed and not a statement of the actual quantity of products prepared. The record of inspection is sometimes duplicated when the product is reinspected during different stages of preparation.

TABLE 7.—*Meat and meat food products prepared and processed under supervision*

Kind of product	Inspection pounds
Placed in cure:	
Beef.....	174, 645, 486
Pork.....	3, 176, 714, 313
All other.....	57, 000, 420
Sausage chopped.....	736, 877, 324
Canned product:	
Beef.....	180, 212, 051
Pork.....	28, 515, 086
All other.....	5, 602, 939
Sterilized product:	
Beef.....	4, 798, 621
Pork.....	10, 758, 226
All other.....	15, 699

TABLE 7.—*Meat and meat food products prepared and processed under supervision*—Continued

Kind of product	Inspection pounds
Pork to be eaten uncooked.....	46, 045, 132
Meat extract.....	633, 068
Lard.....	1, 733, 932, 593
Lard oil.....	1, 635, 270
Lard stearin.....	1, 135, 506
Compound and other substitutes for lard.....	458, 517, 918
Oleo stock and edible tallow.....	64, 469, 893
Oleo oil.....	153, 151, 981
Oleostearin.....	69, 643, 883
Oleomargarine.....	133, 835, 996
Miscellaneous.....	1, 871, 605, 900
Horse meat:	
Cured.....	2, 004, 970
Canned.....	320, 000
Total.....	8, 912, 077, 275

The following quantities of meat and meat food products were condemned on reinspection on account of having become sour, tainted, unclean, rancid, or otherwise unwholesome: Beef, 3,573,448 pounds; pork, 7,112,951 pounds; mutton, 42,023 pounds; veal, 46,538 pounds; goat meat, 252 pounds; horse meat, none; total, 10,775,212 pounds.

MARKET INSPECTION

Market inspection, to facilitate interstate deliveries of meat and products, was conducted in 24 cities.

MEAT AND PRODUCTS CERTIFIED FOR EXPORT

The following products were certified for export by the issuance of 106,316 certificates of inspection: Beef and beef products, 191,075,309 pounds; mutton and mutton products, 3,035,375 pounds; pork and pork products, 1,394,205,841 pounds; horse-meat products, 2,159,230 pounds; total, 1,590,467,755 pounds. In addition 4,765 certificates were issued covering the exportation of 100,322,454 pounds of inedible animal products.

EXEMPTION FROM INSPECTION

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by a farmer on the farm or to retail butchers and dealers, supplying their customers. The retail butchers and dealers, however, in order to ship meat and meat food products in interstate or foreign commerce, are required to obtain certificates of exemption. The number of such certificates outstanding at the close of the fiscal year was 1,628, an increase of 64 over the preceding year. During the year 74 certificates were canceled, 41 on account of dealers' retiring from business or ceasing to make interstate shipments, 15 on account of

change in address, 7 for change in ownership, 5 for violations of the regulations, 4 for insanitary conditions, 1 on account of handling only farm-dressed meats, and 1 because of the granting of regular inspection.

During the year 31,442 shipments were made by retail butchers and dealers holding certificates of exemption, as compared with 35,422 shipments during the fiscal year 1924. Products so shipped are shown in Table 8.

TABLE 8.—*Shipments by retail butchers and dealers under certificates of exemption*

Product	Carcasses	Pounds
Beef, carcasses (257 quarters).....	64	34, 243
Veal, carcasses.....	28, 054	2, 607, 966
Sheep, carcasses.....	1, 038	44, 911
Swine, carcasses.....	661	32, 714
Beef, fresh.....		730, 752
Veal, fresh.....		230, 379
Mutton, fresh.....		109, 470
Pork, fresh.....		69, 378
Cured meats.....		369, 773
Lard.....		21, 061
Sausage.....		101, 391
Miscellaneous (scrapple, lard substitutes, suet, head-cheese, etc.).....		25, 893
Total.....	29, 817	4, 377, 931

During the year 64,093 interstate shipments were made of meat and meat food products from animals slaughtered by farmers on the farm, as compared with 71,150 shipments made in the fiscal year 1924. The products composing these shipments are shown in Table 9.

TABLE 9.—*Shipments of farm-slaughtered products under exemption from inspection*

Product	Carcasses	Pounds
Beef, carcasses (721 quarters).....	180	79, 025
Veal, carcasses.....	86, 944	7, 520, 910
Sheep, carcasses.....	4, 023	143, 559
Swine, carcasses.....	4, 922	522, 437
Beef, fresh.....		44, 709
Veal, fresh.....		106, 105
Mutton, fresh.....		34, 779
Pork, fresh.....		138, 462
Cured meats.....		445, 991
Lard.....		49, 312
Sausage.....		76, 849
Miscellaneous (scrapple, lard substitutes, suet, head-cheese, etc.).....		7, 033
Total.....	96, 069	9, 169, 171

INSPECTION OF IMPORTED MEATS

Table 10 shows the inspection of imported meats and meat food products for the fiscal year.

TABLE 10.—*Imported meat and meat food products inspected and passed*

Country of origin	Fresh and refrigerated meats		Cured and canned meats	Other products	Total weight
	Beef	Other classes			
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Argentina.....	1, 297, 404	163, 518	8, 901, 797	1, 056, 224	11, 418, 943
Australia.....		11, 197	113, 510	389, 468	514, 175
Brazil.....	4, 945	4, 300	43, 310	166, 639	219, 194
Canada.....	4, 025, 615	11, 628, 717	1, 014, 155	669, 548	17, 338, 035
Uruguay.....	284, 636	807	2, 331, 848	236, 431	2, 853, 722
Other countries.....		19, 018	452, 423	359, 330	830, 771
Total.....	5, 612, 600	11, 827, 557	12, 857, 043	2, 877, 640	33, 174, 840

Table 11 shows the amounts of foreign meat and products excluded from the country because of unsoundness, presence of prohibited preservatives, or other failure to comply with the regulations.

TABLE 11.—*Imported meat and meat food products condemned and refused entry*

Product	Condemned	Refused entry
	<i>Pounds</i>	<i>Pounds</i>
Beef.....	873	76, 367
Veal.....	220	90
Pork.....	6, 562	7, 569
Total.....	7, 655	84, 026

INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT

By request of other branches of the Government, reinspections of meat and meat food products to determine whether they remained wholesome and conformed to certain specifications were made during the year, as shown in Table 12.

TABLE 12.—*Inspections for other branches of the Government*

Branch of Government	Passed	Rejected
	<i>Pounds</i>	<i>Pounds</i>
Navy Department.....	53, 217, 397	1, 601, 098
Marine Corps.....	3, 563, 065	258, 596
War Department.....	802, 104	23, 560
Interior Department (Indian Affairs).....	482, 471	695
Shipping Board.....	421, 759	14, 057
Panama Railroad.....	14, 766	—
Public Health Service.....	283, 633	910
Veterans' Bureau.....	400, 379	2, 700
Coast Guard.....	300	—
Total.....	59, 186, 374	1, 901, 616

MEAT-INSPECTION LABORATORIES

Laboratory analyses and examinations of meat and meat food products and of substances used in connection with their preparation were conducted in the meat-inspection laboratories situated in the several districts throughout the country.

The total number of samples analyzed was 41,760, of which 518 represented meat and meat food products offered for importation. Samples of 1,030 domestic and 75 foreign products were found to be not in accordance with the regulations.

Samples of water supplies, curing materials, spices, condiments, cereals, coloring materials, denaturing oils, etc., were examined. Of 2,163 water samples 185 showed evidence of pollution.

A study of the keeping qualities of lard showed that the most important factors affecting keeping quality are the condition of the fats when rendered and the method of rendering.

Experiments with the use of sodium nitrite in meat curing were continued and were uniformly successful.

The work on the souring of hams was continued and has yielded important results. It has been definitely established that a hog carcass free from the bacteria commonly associated with ham souring can not be produced by any practicable method of slaughtering or of handling subsequent to slaughter.

Other special studies have dealt with the products of the dry rendering system, with the use of cereal in sausage, with the composition and food value of Frankfurter-style sausage, and with the correct proportion of nitrates for curing.

LABELING MEAT AND PRODUCTS

Efforts toward simplifying the approval of labels for meat were continued, and as a result there is a marked decrease in the quantity of material submitted by packers to the bureau for approval. Approvals for the year numbered 10,174, while 100,277 labels previously approved, were eliminated from the current files. A further reduction of the approvals is in progress.

A proposed amendment to the regulations, to permit the designation of the animal-fat constituents of lard substitutes as "animal fat" in lieu of the specific names of the fats, is designed to reduce the multiplicity of labels required for such products and to remove in a large measure the restrictions on advertising meat where the use of the inspection legend is involved.

FIELD INSPECTION DIVISION

The Field Inspection Division, under A. W. Miller, chief, conducted the field work of eradicating outbreaks of foot-and-mouth disease in California and Texas and European fowl pest in a number of Eastern and Midwestern States and continued its regular activities for the control and eradication of certain other diseases of livestock, the enforcement of livestock quarantine and transportation laws, and the administration of regulations governing the importation and exportation of livestock and those providing for the sanitary handling and control of hides, skins, wool, other animal by-products, hay, straw, forage, etc., offered for importation into the United States.

ERADICATION OF FOOT-AND-MOUTH DISEASE

FURTHER OUTBREAKS IN CALIFORNIA SUPPRESSED

Foot-and-mouth disease, which was discovered in California in February, 1924, had been brought well under control by the beginning of the fiscal year, July 1, 1924. Further outbreaks occurred only in the three counties of Los Angeles, Tuolumne, and Merced, the last outbreaks among domestic livestock in those counties appearing, respectively, August 23, October 9, and April 5. The outbreak of April 5 was a recurrence of the disease on previously infected premises and was not a new infection. Diseased herds were promptly slaughtered and buried, fre-

quently on the same day that infection was discovered, and the premises were promptly disinfected. In the testing and restocking of 702 previously infected premises the disease reappeared on only 2.

As conditions improved, counties and parts of counties which were considered free from the disease were released from quarantine. The procedure of releasing individual premises was simplified as much as possible so as to permit dairymen and other livestock owners to resume their business as promptly as was considered safe. Amendment 30 to B. A. I. Order 287, effective January 1, 1925, removed the quarantine from all areas not previously released, except a small part of Mariposa County, that part of Tuolumne County outside the Stanislaus National Forest, and all of that forest. Restrictions were continued on these quarantined areas during the remainder of the year on account of infection in deer.

In spite of all precautions that could be taken deer in the Stanislaus National Forest contracted the disease from infected cattle with which they mingled. The first infected deer was found July 12, 1924. Eradicating foot-and-mouth disease in deer on the mountainous range was a new and difficult problem for the men engaged in fighting the disease. It was not considered an impossible undertaking, however, and a force was immediately organized to wage a campaign of extermination against deer in the infected area as the only practicable means holding prospect of success. The State department of agriculture, the California Fish and Game Commission, and the Bureau of Biological Survey and the Forest Service of the department cooperated in this undertaking. Leadership in field operations was delegated to the Bureau of Biological Survey. Efforts to confine the disease to a comparatively small area were successful. An intensive and relentless campaign in this area quickly thinned out the deer and reduced the infection, until in May only an occasional animal with acute lesions could be found. The last deer showing evidence of recent infection was killed June 10. The number of deer taken was 20,698. As a precautionary measure the Forest Service, at the suggestion of the Bureau of Animal Industry, closed the Stanislaus National Forest to grazing in 1925.

FOOT-AND-MOUTH DISEASE IN TEXAS

An outbreak of foot-and-mouth disease in Texas was officially confirmed September 27, 1924. The infection first appeared in a herd of Zebu cattle south of Houston. Anticipating a positive diagnosis, the department on September 26 issued an order quarantining Harris and Galveston Counties and those portions of Brazoria and Fort Bend Counties lying east of the Brazos River. On the same day the bureau ordered a number of experienced employees to Houston. This force was increased until 45 inspectors were on the ground. At the request of Governor Neff the department three days later assumed full charge of eradication work in the State, the combined Federal and State forces being placed under the direction of Marion Imes, of the bureau.

The work of eradication was prosecuted vigorously by the usual methods, and in 30 days the outbreak was suppressed, the last diseased herd having been discovered October 27. Operations incident to testing and restocking infected premises were un-

eventful. On January 1, 1925, all quarantine restrictions were removed, except on areas in which the disease had existed, and on April 15 the quarantine on those areas was revoked.

The source of the Texas outbreak was not determined, but it seems probable that the infection entered through a Gulf port. No connection was established between this outbreak and the one in California.

The quarantine and embargo regulations issued by other States because of the Texas outbreak were more uniform and reasonable than those promulgated during the California outbreak. A number of States issued regulations conforming to the Federal regulations, and several States issued no regulations at all, relying entirely on the Federal restrictions for protection.

STATISTICS OF ERADICATION

Table 13 shows the number of domestic animals slaughtered and their appraised value in eradicating foot-and-mouth disease from California and Texas during this fiscal year:

TABLE 13.—*Livestock slaughtered in eradication of foot-and-mouth disease in California and Texas, with appraised values, during fiscal year 1925*

State and county	Herds	Cattle	Sheep	Swine	Goats	Total animals	Appraised value
California:							
Los Angeles.....	17	545	0	37	8	590	\$57,852.10
Merced.....	2	9	0	0	0	9	615.00
Tuolumne.....	62	7,968	3,404	162	564	12,098	289,402.65
Total for California.....	81	8,522	3,404	199	572	12,697	347,869.75
Texas:							
Harris.....	145	8,212	0	69	0	8,281	315,078.50
Galveston.....	3	261	27	0	0	288	9,847.00
Total livestock for Texas.....	148	8,473	27	69	0	8,569	324,925.50
Property destroyed.....							158.86
Grand total for Texas.....							325,084.36
Combined totals for both States....	229	16,995	3,431	268	572	21,266	672,954.11

¹ Of these, 11 herds, containing 3,125 cattle, 27 sheep, and 11 swine, were infected, the remainder exposed.

Treating as a whole the series of outbreaks of foot-and-mouth disease in California in 1924 and 1925, falling within two fiscal years, the statistics of slaughter and appraisal are as follows: Herds, 910; cattle, 58,303; sheep, 28,382; swine, 21,195; goats, 1,380; total domestic livestock, 109,260; deer, 20,698; total animals, 129,958; appraised value of domestic livestock (estimated), \$4,091,192.51; appraised value of property destroyed

(estimated), \$64,588.51; total appraised values, \$4,155,781.02.

ERADICATION OF EUROPEAN FOWL PEST

European fowl pest made its initial appearance in the United States in the fall of 1924. Outbreaks occurred in Pennsylvania, New York, New Jersey, Connecticut, Indiana, Michigan, West Virginia, Missouri, and Illinois. Most of the infection was found in the

first four of the States named. Outbreaks in the other States were few in number and were quickly suppressed.

No funds were available for field work on poultry diseases, but Congress quickly appropriated \$100,000 to combat this deadly malady.

To prevent the spread of the disease, the department issued an order, effective December 22, 1924, prohibiting the interstate shipment of live chickens, turkeys, or geese affected with or directly exposed to European fowl pest, and requiring the cleaning and disinfection of premises, cars, coops, and other equipment that had been used in the handling of interstate shipments of poultry affected with this disease. In the enforcement of this order 2,718 feedings and assembling plants, 8,245 cars, 354,358 coops, and 125,975 pieces of miscellaneous equipment were cleaned and disinfected.

Bureau employees investigated suspected outbreaks of fowl pest and when the diagnosis was confirmed assisted the State authorities in eradicating the affection. This was accomplished by the employment of methods similar to those used in combating foot-and-mouth disease. Affected flocks were slaughtered and, together with the birds that had died, were burned or deeply buried. Thorough cleaning and disinfection of infected premises were carried out under official supervision. Test birds were subsequently introduced on such premises before restocking was commenced, to determine whether the virus of the disease had been destroyed. These measures proved to be so effective that the disease was virtually eradicated by May 1, 1925, infection after that date manifesting itself only in one flock of chickens in New York.

ERADICATION OF SCABIES

Inspectors in the field made 24,953,861 inspections and supervised 4,071,375 dippings of sheep in connection with the work of eradicating sheep scabies, which was continued in cooperation with State officials. On inspection, 1,181,592 sheep were found to be infected, or approximately 15 per cent less than in the preceding year. In the western range States in which the disease is still quite prevalent a decrease is reported in all except South Dakota, Washington, and Wyoming. No infection was found in Montana or Nevada.

In the eradication of scabies in cattle bureau employees in cooperation

with State officials made 3,409,439 inspections and supervised 1,121,459 dippings in the field. On inspection 204,795 cattle were found to be infected, as compared with 279,468 for the preceding year. In Arizona, which for several years has been practically free from cattle scabies, widespread outbreaks occurred, traceable to cattle introduced from other States. Owing to a prolonged drought, disease-eradication work was greatly hampered in Arizona, and at the close of the year large numbers of infected and exposed cattle remained undipped. Inspection reports also indicated somewhat greater prevalence of the disease in Kansas, Nebraska, and South Dakota than in the preceding year. In a number of other States, however, especially Texas, Montana, and Wyoming, conditions were greatly improved.

ERADICATION OF DOURINE

The campaign for the eradication of dourine was continued in cooperation with State livestock sanitary officials and the Office of Indian Affairs with a view to completing the suppression of this disease in the few areas in which it still existed. Infected animals were found only in Arizona and South Dakota, and with few exceptions the diseased horses were owned by Indians. Excellent cooperation was received in rounding up and testing horses belonging to Indians in the infected area in South Dakota, and fine progress was made toward completing the work in that State. In Arizona, however, it was again necessary to curtail activities because the Office of Indian Affairs did not have funds available to employ sufficient help to round up the horses for testing and to indemnify owners for the slaughter of diseased animals. The number of animals tested and the results of the tests are recorded by the Pathological Division.

LIVESTOCK SANITARY WORK IN INTERSTATE COMMERCE

In the supervision of interstate transportation of livestock to prevent the spread of animal diseases bureau employees at public stockyards inspected 21,521,611 cattle, 20,048,718 sheep, and 45,814,678 swine. Of the animals inspected 16,440 cattle and 1,044,956 sheep were dipped under bureau supervision to comply with regulations of the department or of States of destination, and 352,116 swine were immunized against hog cholera and disinfected for shipment

to country points for feeding and breeding purposes. This shows a slight increase over the preceding year in the number of cattle and sheep inspected, a slight decrease in the number of such animals dipped, and a reduction of 6,750,343 in the number of hogs inspected and 157,451 in the number of hogs immunized. The decrease in the number of hogs immunized was not due to a falling off in the demand for feeder and stocker pigs but to shortage in the number of swine received at public stockyards suitable for such purposes.

Experimental work for the control of hemorrhagic septicemia was continued. Arrangements were made to use hemorrhagic-septicemia aggrassin on selected lots of cattle at the Chicago Union Stock Yards to determine whether the aggrassin under stockyards conditions would give any better results than the bacterins. Approximately half the animals of each lot were treated with aggrassin and the other half as a check were shipped without any treatment. The total number of animals handled in this experiment was 4,439, of which 2,234 received aggrassin and 2,205 went forward untreated. Owners were requested to report results, but many failed to do so. The reports received covered 708 treated cattle, with a death loss of 40, and 700 untreated, with a death loss of 17. This experiment and others conducted by the bureau indicate that little if any immunity is conferred on animals that are suffering from hemorrhagic septicemia in the incubative stage.

On request of transportation companies and shippers, or to comply with laws of States to which shipments were destined, bureau veterinarians inspected 19,673 horses and mules, of which 6,197 were tested with mallein, 2 showing reaction. This was an increase over the preceding year of 7,459 inspections, 310 tests, and 2 reactors.

During the year 26,500 cars carrying animals affected with communicable diseases were received at bureau stations. In compliance with department regulations or on request of Canadian Government officials, State officials, or transportation companies 73,158 cars were cleaned and disinfected under bureau supervision. Included in this number were 8,131 cars cleaned and disinfected on account of the outbreaks of foot-and-mouth disease in California and Texas

and 8,245 cars so treated because of European fowl pest.

As has been the practice for a number of years, all ruminants and swine received at public stockyards were carefully inspected for foot-and-mouth disease by experienced veterinary inspectors especially assigned to that work, in order that prompt measures of control and eradication might be initiated should an outbreak occur.

ENFORCEMENT OF TRANSPORTATION AND QUARANTINE LAWS

The bureau continued to report to the Solicitor of the department, for presentation to the Attorney General for prosecution, cases of apparent violations of livestock transportation and quarantine laws. During the fiscal year there were submitted to the Department of Justice 402 cases of alleged violations of the law which prohibits the confinement of animals in cars longer than 28 hours without feed, water, and rest, and 52 cases of alleged violations of the quarantine laws and regulations. Many of these cases required special investigation on the part of bureau employees, such as interviewing witnesses and examining railroad and other records to procure evidence. Four bureau employees were regularly assigned to this work, although most of the collection of evidence and preparing and submitting reports was done by bureau employees at stockyards centers in connection with their other duties. The penalties imposed in the cases decided in favor of the Government amounted to \$53,825 for violations of the livestock transportation law and \$6,510 for violations of the quarantine laws and regulations.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS

Although importations of livestock during the year showed a somewhat increased volume over that for the preceding year, the number of animals entering the country remained relatively small. The prevalence of foot-and-mouth disease and other serious animal plagues in most foreign countries made it necessary to refuse many applications for permits to import ruminants and swine. Aside from those brought in from Canada and Mexico, importations of cattle were practically limited to animals from the islands of Jersey and Guernsey. Owing to repeated outbreaks of foot-

and-mouth disease in England it was required that all cattle from those islands proceed to the United States

without landing in Great Britain. Importations of various kinds of livestock are shown in Tables 14 and 15.

TABLE 14.—*Imported animals inspected and quarantined*

Port of entry	Cattle	Sheep	Swine	Goats	Horses	Other animals
New York.....	613	5	9	120	79	121
Boston.....	2				2	
Baltimore.....						13
Los Angeles.....						7
San Diego.....						3
San Francisco.....						5
New Orleans.....			4			2
San Juan, Porto Rico.....	4					
Canadian border ports.....	480	1	145		16	3
Total.....	1,099	6	158	120	97	154

TABLE 15.—*Imported animals inspected but not quarantined*

Port of entry	Cattle	Sheep	Swine	Goats	Horses	Other animals
New York.....					1 850	
Boston.....					37	
Baltimore.....						12
San Juan, Porto Rico.....	660		25	3	102	22
New Orleans.....					3	
Galveston.....						21
Houston.....						14
Key West.....					595	
Portland, Oreg.....				1		
San Francisco.....						247
Spokane.....						1
Philadelphia.....					2	
Detroit.....						1
Mexican border ports.....	73,192	84,414	1,942	2,795	6,703	13
Canadian border ports.....	128,674	27,089	87,385	43	7,102	583
Total.....	202,526	111,503	89,352	2,842	15,394	914

¹ Nine zebras included.

Of the 120 goats shown in Table 14, 117 were Angoras from the Union of South Africa. This is the first time in many years that goats have been permitted importation from the Union.

Quail from Mexico to the number of 39,170 imported under regulations of the Bureau of Biological Survey were inspected and quarantined by inspectors of this bureau.

Cattle from the Channel Islands were tested with tuberculin both prior to shipment and after arrival in the United States. Results of tests applied during the quarantine period at ports of entry are shown in Table 16.

TABLE 16.—*Tuberculin tests at quarantine stations of cattle imported from abroad*

Breed	Tested	Passed	Rejected
Jersey.....	315	315	0
Guernsey.....	236	236	0
Total.....	551	551	0

IMPORTATION OF ANIMAL BY-PRODUCTS, FEEDING MATERIALS, ETC.

B. A. I. Order 286, effective September 1, 1924, superseded Joint Order No. 2 of the United States Treasury Department and Department of Agriculture. This order was made very comprehensive, with a view to placing under sanitary supervision all import animal by-products and feeding materials which might possibly serve as carriers of foot-and-mouth disease and anthrax. In the administration of these regulations there has been very general cooperation on the part of importers, who seem to appreciate the fact that merchandise of this character should not be shipped into the United States from badly infected foreign countries without due precautions.

It is the practice of foreign shippers to use secondhand bags as containers for certain animal fertilizer and other products which have been subjected to heat in process of manufacture and which consequently in

themselves may be considered safe. Although the exact degree of danger from old bags is not definitely known, restrictions have been placed on such bags from countries in which foot-and-mouth disease exists in order to prevent their use or shipment to farms in the United States without proper disinfection.

Through the substitution of other packing materials, hay and straw packing from foreign countries has been reduced to a minimum. In cases in which merchandise has come from infected countries packed in hay or straw not satisfactorily disinfected prior to shipment, special care has been taken to accomplish the destruction of such packing after arrival in this country.

Pending the installation of chlorinating apparatus or connection of the tannery with an approved sewerage system, tanners have been permitted to receive restricted import hides and skins subject to disinfection during the process of handling preliminary to tanning. During the year a number of tanners with plants discharging effluents into inland streams installed chlorinating apparatus in order to guard against the contamination with anthrax of lands bordering such streams.

In cooperation with the National Association of the Fur Industry a plan was adopted for the handling of hides and skins of small ruminants imported for furriers' use in a manner to afford adequate protection and at the same time render unnecessary a complete change in established practices of this trade.

INSPECTIONS OF ANIMALS FOR EXPORT

The inspection of export livestock and supervision over the fitting of vessels to insure the humane handling and safe transport of export animals have been continued under provisions of the department's regulations. Inspections have also been made and certificates issued so far as possible to meet any additional requirements of foreign countries. Table 17 indicates the number of animals of various kinds inspected for export.

TABLE 17.—*Inspections of animals for export*

Kinds of animals	To Canada	To other countries		Total
		American animals	Canadian animals ¹	
Cattle.....	586	4,690	19,329	24,605
Sheep.....	17,578	151	-----	17,729
Swine.....	6	274	-----	280
Goats.....	4	19	6	29
Horses.....	1,043	1,844	-----	2,887
Mules.....	9	4,713	-----	4,722
Total....	19,226	11,691	19,335	50,252

¹ Animals of Canadian origin exported through United States ports.

Inspections of 314 vessels carrying livestock were made before clearance.

For shipment to Canada 1,043 horses and 9 mules were tested with mallein, 586 cattle were tested with tuberculin, and 17,578 sheep, 6 swine, and 4 goats were inspected.

For shipment to other countries 92 horses and 51 mules were tested with mallein; the tuberculin test was applied to 7,958 cattle, with 18 reactors, and inspections were made of 198 sheep, 24 swine, and 13 goats.

TUBERCULOSIS ERADICATION DIVISION

Continued progress was made in the cooperative work of eradicating animal tuberculosis, conducted by the Tuberculosis Eradication Division under the direction of J. A. Kiernan, chief. The cooperation among the respective State, county, municipal, and Federal officials was further strengthened and improved. With increased appropriations, improved State laws, and a better understanding on the part of livestock owners, more definite plans looking to the absolute eradication of the disease were formulated. These plans are based on the extension of the area plan of eradication, which is now generally recognized as the best method for intensive work and definite results.

An average of 214 regularly employed bureau veterinarians were engaged in the work under the super-

vision of the inspectors in charge of 44 field offices. The respective State livestock sanitary officials were responsible for the employment of an average of approximately 221 veterinarians throughout the year. In addition, an average of about 231 regular veterinary inspectors were employed by the many counties engaged in intensive area work or by municipal authorities or other official or semi-official agencies. Thus there was a total average of 666 veterinarians employed exclusively in the work of tuberculosis eradication throughout the year. The most marked increase was in the county veterinarians. The States also had an increased number of regular employees.

Both State and Federal appropriations were increased over the preceding fiscal year. The Federal appropriation was \$3,277,600, of which \$850,000 was allotted for operating expenses and \$2,427,600 for indemnity purposes. This is an increase of \$400,000 for indemnity for the year. The combined State appropriations were approximately \$7,000,000. This increase in funds made possible an increase of about 32 per cent in the number of cattle tested.

The four main projects of the eradication work were continued, namely: (1) Eradication of tuberculosis from herds of cattle under the "accredited-herd" plan; (2) eradication of tuberculosis from circumscribed areas; (3) eradication of tuberculosis from swine; (4) control of the tuberculin testing of cattle intended for interstate shipment through supervision of the work done by practicing veteri-

narians on the approved list and at public stockyards. The extent of tuberculosis in fowls was also investigated.

ACCREDITED TUBERCULOSIS-FREE HERDS

Although preference was given to the area project, tuberculin testing under the accredited-herd plan was conducted in all States. At the conclusion of the fiscal year there were listed as fully accredited 72,383 herds containing 1,275,063 cattle, an increase of 24,110 herds containing 354,693 cattle. In addition 921,758 herds containing 8,047,540 cattle passed one test in the process of becoming accredited. This was an increase of 392,740 herds and 3,274,704 cattle. The total herds and cattle under supervision at the end of the fiscal year numbered, respectively, 1,120,526 and 11,392,381. At the end of the year there were on the waiting list 403,949 herds containing more than 3,500,000 cattle.

In connection with this work, and also in the course of the area eradication work (reported under another heading), the tuberculin test was applied to 607,344 herds containing 7,000,028 cattle, of which 214,491 cattle, or 3.1 per cent, were condemned as diseased. The percentage of condemnations is very slightly less than for the preceding year, having been 3.2 per cent for the fiscal year 1924. Table 18 shows by years the number of cattle tested, the number and percentage of reactors, and the number of accredited and once-tested herds and cattle.

TABLE 18.—*Progress of work of establishing accredited herds free of tuberculosis*

Fiscal year	Cattle tested ¹	Number of reactors	Per cent of reactors	Accredited		Passed one test	
				Herds	Cattle	Herds	Cattle
1918.....	134,143	6,544	4.9	204	6,945	883	22,212
1919.....	329,878	13,528	4.1	782	19,021	6,535	117,243
1920.....	700,670	28,709	4.1	3,370	82,986	16,599	197,577
1921.....	1,366,358	53,768	3.9	8,201	193,620	49,814	643,233
1922.....	2,384,236	82,569	3.5	16,216	363,902	161,533	1,548,183
1923.....	3,460,849	113,844	3.3	28,526	615,156	312,281	2,724,497
1924.....	5,312,364	171,559	3.2	48,273	920,370	529,018	4,772,836
1925.....	7,000,028	214,491	3.1	72,383	1,275,063	921,758	8,047,540

¹ Includes testing under area plan.

The total number of cattle tested during the period from 1918 to 1925, inclusive, is 20,688,526, with 685,012 reactors, or 3.3 per cent.

A survey of nearly 37,000 herds in practically all of the 48 States indi-

cates a growth in the testing being narians who have passed an examination to determine their efficiency for the work. At the end of the year 6,412 such accredited men were on the list. The survey showed that the testing of approximately 62 per cent of

the accredited herds due for retest had been turned over to accredited practitioners, and that 63 per cent of that number had actually been retested. Figures reported by the field offices show that during the fiscal year accredited veterinarians under this plan tested 32,606 herds, containing more than 605,000 cattle, an increase of 37 per cent over the preceding year.

Another survey of nearly 19,000 accredited herds was made to determine the number of such herds removed from the accredited list by reason of infection being found on succeeding tests. Only 984 such infected herds, or approximately 5 per cent, had been removed from the list. Although an accurate history of all the removed herds was not available, it was found that the causes of reinfection of a large number of such herds were the addition of infected cattle to the accredited herds, the exposure of the accredited cattle to infected cattle as on show circuits, etc., and the feeding of unpasteurized raw milk from unknown sources. This survey also indicated that it is entirely possible to maintain

herds free from tuberculosis under the proper restrictions as to sanitation and association with other cattle.

ERADICATION OF TUBERCULOSIS FROM AREAS

Rapid progress was made in the eradication of tuberculosis from cattle within circumscribed areas. About 71 per cent of the total number of cattle tested in the whole work of tuberculosis eradication were tested under this plan. Results continue to demonstrate the value and efficiency of the plan. At the close of the fiscal year 591 counties had engaged in eradication under this plan. This is an increase of 273 counties, or 86 per cent, over the number reported for the preceding year. The counties spent approximately \$700,000 on such work, an increase of more than \$225,000. Many State legislatures enacted legislation improving existing laws relative to area work or passed entirely new legislation looking to more rapid progress. The status of the area work is shown in Table 19.

TABLE 19.—*Status of tuberculosis eradication from county areas at close of fiscal year ended June 30, 1925*

State	Counties completing one or more tests of all cattle ¹	Counties intensively engaged in testing	Total counties engaged	Modified accredited areas	Cattle tested during year
Alabama.....		3	3		5,479
Arizona.....		4	4		30,719
California.....	2		2	2	20,427
Colorado ²					21
District of Columbia.....	1		1		553
Florida.....	3	1	4	3	969
Georgia.....		1	1		1,614
Idaho.....	4	9	13	1	72,106
Illinois.....	1	61	62	1	586,991
Indiana.....	9	15	24	6	168,000
Iowa.....	6	39	45	6	1,000,221
Kansas.....	5	5	10	5	138,263
Kentucky.....	15	12	27		77,864
Maine.....		16	16		15,353
Maryland.....		6	6		59,988
Michigan.....	28	2	30	9	390,887
Minnesota.....	5		5	3	209,675
Mississippi.....	4		4		2,287
Missouri.....		28	28		64,314
Montana.....	2	4	6		20,381
Nebraska.....	7	9	16	2	262,449
Nevada.....		6	6		8,499
New Hampshire.....		5	5		22,401
New Mexico.....		12	12		12,450
New York.....	4	36	40	1	467,971
North Carolina.....	37	23	60	37	138,393
North Dakota.....	5	18	23	5	152,791
Ohio.....	5	14	19		193,903
Oregon.....	10	8	18	1	66,107
Pennsylvania.....	3	12	15	3	122,238
Tennessee.....	3	1	4	3	3,712
Utah.....	2	11	13	1	54,815
Virginia.....	2	1	3		18,955
Washington.....	3	31	34		91,261
West Virginia.....	1	2	3		14,205
Wisconsin.....	28	1	29		486,898
Wyoming ²		1			8,895
Total.....	195	396	591	89	4,992,055

¹ Including modified accredited areas. ² Testing reported done under community or township plan.

STATISTICS OF SLAUGHTER AND INDEMNITY

In administering the appropriations for operating expenses and for the payment of indemnity for diseased cattle slaughtered, every effort was made to practice economy and to conserve the funds so as to accomplish the largest results with the available means. Great care was exercised in

every State and at every marketing point in order to obtain the maximum of salvage from slaughtered animals and thus lessen to that extent the amounts to be paid from State and Federal funds.

Statistics of the slaughter of reacting cattle, the indemnity allowed, salvage realized, etc., are given in Table 20.

TABLE 20.—Cattle slaughtered, appraised value, indemnity allowed, and salvage realized in work of tuberculosis eradication

State	Cattle slaughtered	Average appraisal per head	State indemnity	Federal indemnity	Average State indemnity per head	Average Federal indemnity per head	Average salvage per head
Arizona.....	1,573	\$95.62	\$38,061.19	\$37,208.38	\$24.20	\$23.65	\$15.26
Colorado.....	68	187.94	2,397.80	2,397.80	35.26	35.26	13.15
Connecticut.....	2,662	63.29	68,888.80	32,419.09	25.88	12.18	24.01
Delaware.....	1,632	67.91	45,125.70	29,744.29	27.65	18.23	13.19
District of Columbia.....	1	90.00	24.60	24.60	24.60	24.60	16.00
Florida.....	187	28.22	2,550.50	1,225.54	13.64	6.55	7.76
Hawaii.....	157	247.23	8,825.00	4,047.52	56.21	25.78	54.85
Idaho.....	495	37.42	4,859.10	4,859.10	9.82	9.82	8.27
Illinois.....	14,228	73.13	234,810.66	234,810.66	16.50	16.50	18.21
Indiana.....	3,263	94.47	86,005.76	70,060.05	26.36	21.47	19.42
Iowa.....	12,269	71.52	141,137.09	141,137.09	11.50	11.50	20.75
Kansas.....	1,126	62.30	16,954.20	16,954.20	15.06	15.06	19.09
Kentucky.....	574	47.99	13,530.15	6,255.12	23.57	10.90	11.99
Maine ¹	832	87.49	46,140.61	16,092.37	55.46	19.34	11.54
Maryland.....	7,625	74.45	144,025.20	144,025.20	18.89	18.89	19.38
Massachusetts.....	3,897	117.74	106,074.00	106,074.00	27.33	27.33	21.70
Michigan.....	5,358	69.05	162,584.71	74,752.23	30.34	13.95	16.53
Minnesota.....	8,552	57.27	185,784.72	94,635.84	21.72	11.07	22.59
Mississippi.....	25	35.40	223.68	215.34	8.94	8.61	1.29
Missouri.....	547	135.49	16,082.92	16,082.92	29.40	29.40	21.13
Montana ¹	384	48.73	13,444.22	5,404.94	35.01	14.08	5.10
Nebraska.....	1,950	80.33	27,390.39	27,390.39	14.05	14.05	24.46
Nevada.....	110	99.99	2,116.12	1,817.96	19.24	16.53	14.87
New Hampshire.....	1,221	73.00	41,769.46	22,339.68	34.21	18.30	18.02
New Jersey.....	4,278	92.00	100,438.92	94,591.38	23.48	22.11	20.95
New Mexico.....	21	49.43	446.32	446.32	21.25	21.25	-----
New York.....	4,500	93.64	256,831.36	70,426.60	57.07	15.65	18.64
North Carolina.....	420	76.40	8,907.08	8,907.08	21.21	21.21	5.72
North Dakota.....	1,875	46.61	17,754.62	17,754.62	9.47	9.47	16.67
Ohio.....	6,540	74.46	120,321.18	120,321.18	18.40	18.40	23.26
Oklahoma.....	87	80.69	1,637.98	1,379.94	18.83	15.86	18.44
Oregon.....	882	86.26	14,152.77	14,152.77	16.06	16.06	12.85
Pennsylvania.....	7,345	104.32	297,160.90	182,675.91	40.46	24.87	17.28
Rhode Island.....	66	114.39	3,255.00	1,310.93	49.32	19.86	23.52
South Carolina.....	92	73.12	1,487.67	1,487.67	16.17	16.17	24.07
South Dakota.....	561	80.66	14,975.00	9,298.86	26.69	16.58	23.02
Tennessee.....	3	366.67	300.00	150.00	100.00	50.00	68.58
Texas.....	333	96.68	7,828.20	7,828.20	23.51	23.51	7.95
Utah.....	497	77.12	9,114.02	9,114.02	18.34	18.34	16.96
Vermont.....	3,249	75.54	52,551.66	52,551.66	16.17	16.17	10.81
Virginia.....	754	91.49	28,285.66	16,705.46	37.51	22.16	15.33
Washington.....	1,438	100.91	33,504.97	33,504.97	23.30	23.30	17.10
West Virginia.....	529	76.33	22,872.76	11,003.66	43.23	20.80	9.11
Wisconsin.....	9,345	93.13	165,538.40	165,538.40	17.71	17.71	20.50
Wyoming.....	203	70.35	2,402.53	2,402.53	11.84	11.84	16.36
Total.....	111,754	79.89	2,568,548.98	1,911,526.47	22.99	17.11	19.12

¹ Salvage paid to State.

ERADICATION OF TUBERCULOSIS FROM SWINE AND FOWLS

The problem of eradicating tuberculosis from swine has become especially interesting in view of the premium being paid by a number of packers for swine from areas officially declared to be free from the disease

under the area plan. Reports from a number of the modified accredited areas indicate that swine owners have realized a substantial sum in this way.

The testing of breeding herds of swine and the tracing of new centers of infection on the basis of slaughterhouse reports were continued. In-

vestigations regarding the source of infection of tuberculosis in swine were also continued with a view to determining to what extent such infection might be traced to tuberculous fowls. The question of fowl tuberculosis has thus become a very important phase of the tuberculosis-eradication problem.

A survey begun in February, 1925, covered the inspection of approximately 76,000 poultry flocks, including nearly 5,108,000 fowls, in 40 States. About 4,690 of these flocks were found to be infected with tuberculosis. These inspections were made in the course of the routine testing of cattle by regularly employed veterinary inspectors. The procedure, in brief, was as follows: Inspection of the flock for "light" birds; study of the history as given by the owner; autopsies on suspected birds, followed by advice relative to control measures, including the slaughter of infected birds; culling or total destruction of the flock; tuberculin testing in flocks sufficiently valuable to make it economically worth while, and proper sanitation.

On the basis of the survey mentioned a map was prepared showing the approximate extent of tuberculosis infection among fowls throughout the country. This preliminary map serves the purpose of calling the attention of the swine and poultry industries to the losses due to fowl tuberculosis. The information at hand indicates that the center of infection in poultry lies in the Middle West and Western States as far as the Dakotas and Nebraska. The connection between swine and fowl tuberculosis shows the necessity for a close study of this phase of the problem and the laying of plans in the infected States for the eradication of the disease from poultry flocks. The bureau is giving assistance to that end.

REGULATION OF INTERSTATE MOVEMENT OF CATTLE

Most of the tuberculin testing of cattle for interstate movement was done by approved veterinary practitioners, of whom 8,813 are on the list approved by State and Federal officials. These men tested for interstate shipment 23,715 herds containing approximately 280,000 cattle, of which 0.8 per cent reacted. This is an increase of about 45,000 over the number of cattle tested by them in the fiscal year 1924. Bureau inspectors tested at public stockyards 48,360 cattle, of which 873, or 1.8 per cent, reacted.

Permits were issued for the interstate movement of 56,410 known reactors for immediate slaughter and of 2 animals returned to the original owner for breeding purposes.

TUBERCULIN TESTING

Tuberculin tests were made by the various methods as follows: Intradermic alone, 5,786,559 cattle, 139,487 reactors, 2.4 per cent; subcutaneous alone, 4,624 cattle, 382 reactors, 8.3 per cent; ophthalmic alone, 157 cattle, 2 reactors, 1.3 per cent; combination of tests, 1,181,892 cattle, 75,117 reactors, 6.4 per cent.

Of the 7,000,000 cattle reported tested during the year about 28 per cent were tested by bureau inspectors and about 72 per cent by State, county, municipal, and accredited practicing veterinarians.

A further study was made of cases in which no visible lesions of tuberculosis were noted on post-mortem examination of slaughtered reacting cattle. About 60 per cent of such cases were found to have originated in herds known to harbor infection.

The average cost of testing by bureau field veterinarians, including salaries and expenses but not office expenses or salaries of supervising officers, was 33 cents a head, in comparison with 30 cents for 1924 and 35 cents for 1923. The slight increase is due partly to salary adjustments and partly to the lessened volume of testing by bureau veterinarians, who have been called on to give more supervision to the work of county and accredited veterinarians. The average cost of testing by all field agencies, including State and county organizations, was materially lessened.

CONFERENCES AND PUBLICITY ON TUBERCULOSIS ERADICATION

The usual Eastern States conference on tuberculosis was held at Providence, R. I., June 16 and 17, 1925, and was largely attended by bureau and State officials, practicing veterinarians, livestock owners, representatives of breeders' associations, public health officials, county agents, and others. Numerous State and local meetings of veterinarians and livestock owners were also attended and addressed by representatives of the Tuberculosis Eradication Division.

A wide distribution of department literature on tuberculosis was continued. New posters on tuberculosis in swine and poultry and a "war map" showing the extent and distribution of bovine tuberculosis were

issued. A number of small exhibits were also prepared and distributed for use at county fairs, local meetings, and other places.

TICK ERADICATION DIVISION

The Tick Eradication Division, under the direction of R. A. Ramsay, chief, continued its cooperation with State and county authorities in 10 Southern States in suppressing Texas or tick fever of cattle and in eradicating the ticks which transmit that disease.

TICK ERADICATION

The field activities were continued under the regional direction of nine field stations which at the close of the fiscal year had a total field force of 262 veterinarians and other employees working in cooperation with 332 State inspectors and 510 county employees. The field office directing the work in Georgia and Florida was moved from Atlanta, Ga., to Jacksonville, Fla., in order to be closer to the center of activities, which has moved gradually southward from year to year with the reduction of the infested area in Georgia.

Under the supervision of the co-operating forces 24,079,918 inspections or dippings of cattle were conducted

and more than 25,000 dipping vats were used in these official dippings. The bureau continued to urge the advisability of giving special attention to the completion of tick eradication in areas that had been released from Federal quarantine but in which a small amount of infestation remained.

During the active tick-eradication season of 1924 the ticks were completely eradicated from 71 additional counties. The following areas were released from Federal quarantine during the fiscal year: One county and parts of 2 counties in Arkansas; 1 county in Florida; 4 counties in Georgia; 5 counties and parts of 2 counties in North Carolina; 1 county in Oklahoma; 13 counties and parts of 2 counties in Texas. During the same period the following areas were re-quarantined: One county in Alabama, 2 parishes in Louisiana, and 7 counties in Texas. The removal of the quarantine from the last 4 counties in Georgia, December 15, 1924, marked the release of the entire State from Federal quarantine.

The results obtained are shown in Table 21, which also shows the progress made in tick eradication since its beginning, in 1906, and gives the status of the work at the close of the fiscal year 1925.

TABLE 21.—Progress of tick eradication since the beginning, and status of the work June 30, 1925

States	Counties under quarantine		Counties released to June 30, 1925	Released counties, tick free		
	July 1, 1906	June 30, 1925		Nov. 1, 1922	Nov. 1, 1923	Nov. 1, 1924
Alabama.....	67	8	59	15	26	41
Arkansas.....	75	37	38	16	21	34
California.....	15	0	15	15	15	15
Florida.....	58	53	5	3	3	1
Georgia.....	157	0	157	101	119	138
Kentucky.....	2	0	2	2	2	2
Louisiana.....	65	38	27	3	3	4
Mississippi.....	81	23	58	37	47	54
Missouri.....	4	0	4	4	4	4
North Carolina.....	75	7	68	40	46	53
Oklahoma.....	61	5	56	35	47	49
South Carolina.....	44	2	42	29	35	36
Tennessee.....	42	0	42	41	41	42
Texas.....	199	94	105	44	49	56
Virginia.....	30	4	26	(1)	(1)	(1)
Total.....	975	271	704	385	458	529

¹ No cooperation by State with bureau from Nov. 1, 1922, to Nov. 1, 1924.

SHIPMENTS FROM QUARANTINED AREAS

The decline in the shipments of southern cattle from quarantined areas to market centers continued

during the year. Only 327,561 of this class of cattle were thus shipped for immediate slaughter, as compared with 387,819 during the preceding year.

In the enforcement of department regulations governing the interstate

movement of cattle from the quarantined area for purposes other than immediate slaughter every effort was made to have the disinfection and inspection of this class of cattle so thorough as to safeguard completely the tick-free areas to which these shipments were made. In the movement of this class of cattle from the field 184,093 head were inspected or dipped and certified for interstate movement. To cover these shipments 5,501 certificates were issued. At public stockyards 48,326 cattle were dipped and certified for movement as noninfectious, for which 688 certificates were issued.

MOTION PICTURES IN STIMULATING TICK ERADICATION

The use of motion pictures as a means of showing proper methods of conducting tick eradication and the benefits to be derived, and as an agent in molding favorable sentiment for this work, was continued with gratifying results with two portable motion-picture outfits. With these machines exhibitions were given in small towns and rural schoolhouses in the tick-infested districts of Arkansas, Alabama, Florida, North Carolina, South Carolina, and Texas. There were 530 exhibitions given to audiences aggregating 87,000 persons.

DIVISION OF HOG-CHOLERA CONTROL

Activities for the control and reduction of hog cholera were continued through the Division of Hog-Cholera Control under U. G. Houck, chief. The methods and policies were similar to those followed in recent years. In general the bureau veterinarians engaged in this work attended meetings and held interviews with farmers and others interested in the reduction of losses from hog cholera, visited farms to investigate conditions and determine causes of infection, examined live and dead animals to diagnose disease, treated hogs either as demonstrations or to assist practicing veterinarians, and gave advice generally on the handling of outbreaks of hog cholera.

CHOLERA LOSSES REDUCED

At no time since records of losses from hog cholera have been kept has the death rate from this disease been so low as during the fiscal year 1925. The disease was at a low ebb throughout the year, and the losses were light compared with those of any previous

year. This year only 30.88 hogs out of every 1,000 on farms in the United States died of hog cholera, whereas in 1897 the loss was 130 and in 1914 it was 106 per 1,000. A disturbing factor, however, is the fact that many of the swine herds on farms have been left susceptible to hog cholera. Since the disease has not been so prevalent as usual, farmers have failed to have their hogs immunized, and were the disease to begin spreading again some heavy losses would probably occur before outbreaks could be checked.

WORK FOR CONTROL OF HOG CHOLERA

Activities looking to the further reduction of cholera losses were carried on during the year in cooperation with 32 States. Owing to the prevalence of foot-and-mouth disease early in the year in California and Texas many of the employees regularly assigned to hog-cholera control were transferred temporarily to assist in the eradication of the former plague, so that the amount of work done in some States was much less than during the preceding year. Thirty-nine bureau veterinarians were engaged on the project. The States cooperating assigned a total of 30 veterinarians to the work.

Bureau inspectors attended 834 meetings and delivered 607 addresses on hog cholera and other swine diseases. The attendance at these meetings numbered 46,745 persons, including farmers, practicing veterinarians, and others. In the course of the year 76,365 persons, including farmers, practicing veterinarians, merchants, bankers, and others, were interviewed on matters relating to hog cholera and its control. The bureau veterinarians made 22,795 visits to farms to investigate conditions, make sanitary surveys, and give advice regarding the prevention of swine diseases and the reduction of losses therefrom, and made 2,162 post-mortem examinations to diagnose diseases. They gave 1,442 demonstrations in the use of the preventive treatment, in the course of which 32,878 hogs were treated. These demonstrations were attended by 4,577 owners of swine and other interested spectators. Assistance was rendered to practicing veterinarians in the treatment of 211 well herds and 145 infected herds numbering 9,838 hogs. In the Southern States, in communities where the services of veterinary practitioners were not available, 130 laymen were trained to administer the preventive serum treatment and their

work was supervised. A total of 2,971 outbreaks of cholera were reported to the bureau inspectors.

INCIDENTAL WORK AGAINST VARIOUS SWINE DISEASES

In connection with the work of hog-cholera control bureau veterinarians diagnosed swine diseases as follows: Cholera, 1,687 cases; pneumonia, 160 cases; necrobacillosis, 129 cases; tuberculosis, 39 cases; other diseases and conditions, such as hemorrhagic septicemia, parasitism, dietary troubles, etc., 729 cases.

In addition to their other duties the bureau veterinarians engaged on the hog-cholera project in a number of States cooperated with the Zoological Division of the bureau and with extension workers of State agricultural colleges in bringing to the attention of hog growers the advantages of swine sanitation in preventing losses from internal parasites and reducing the hazards of hog cholera and similar infections.

DIVISION OF VIRUS-SERUM CONTROL

The administrative and regulatory work under the virus-serum-toxin act of 1913 was continued by the Division of Virus-Serum Control under the direction of D. I. Skidmore, chief. The work consisted of the issuance of licenses to establishments producing veterinary biological products intended for sale in interstate commerce, the inspection of such establishments as to sanitary conditions and methods of production, the supervision of the production and the testing of products, the certification of products for exportation, and the issuance of permits for the importation of biological products from abroad.

WORK AT LICENSED ESTABLISHMENTS

At the close of the year 91 establishments in 60 cities and towns in 20 States were operating under license and inspection, as compared with 94 at the end of the preceding year. Fifty-five of the establishments were engaged in producing only anti-hog-cholera serum and hog-cholera virus, 28 in producing other biological products, and 8 in producing both classes of products. Among the products were antisera, aggressins, bacterins, vaccines, tuberculin, mallein, etc. Inspectors of the bureau supervised the production and testing of anti-hog-cholera serum and hog-cholera virus, while periodical visits of inspection were made to establishments produc-

ing other products, when cultures of organisms and samples of products were collected for examination.

An average of 89 inspectors were maintained in the field. They examined and admitted into licensed establishments 216,768 hogs and 1,490 calves. Twenty hogs were rejected at the time they were offered for admission and 9,462 hogs were rejected after admission because of conditions which made them unsuitable for the production or testing of biological products. The inspectors supervised 6,201 potency and 4,975 purity tests of anti-hog-cholera serum and 1,968 and 1,249 tests of hog-cholera virus for virulence and purity, respectively.

Eighty-six of the samples of biological products collected by the inspectors were subjected to laboratory examination, and of these 60 were found to be satisfactory and 26 unsatisfactory or contaminated. One hundred and four subcultures, embracing 185 strains of organisms intended for use in the preparation of biological products by licensed establishments, were also subjected to laboratory examination, and 170 of these strains were found to be satisfactory and 15 unsatisfactory.

OUTPUT OF BIOLOGICAL PRODUCTS

The quantity of anti-hog-cholera serum produced by licensed establishments was 434,888,994 cubic centimeters, of which 299,446,329 cubic centimeters was ordinary serum and 135,442,665 cubic centimeters clarified serum. The quantity of simultaneous hog-cholera virus produced was 33,153,654 cubic centimeters, while the production of hyperimmunizing virus amounted to 72,490,686 cubic centimeters and inoculating virus 274,985 cubic centimeters, making the total quantity of virus 105,919,325 cubic centimeters.

The production of other biological products by licensed establishments aggregated 23,860,776 doses, classified as follows: Bacterins, 6,245,796; vaccines and viruses, 6,591,502; aggressins, 5,148,383; tuberculin, 3,112,458; avian tuberculin, 243,524; mallein, 45,164; antisera and sera, 2,473,949.

PRODUCTS REJECTED

A total of 9,360,296 cubic centimeters of anti-hog-cholera serum was destroyed as unfit for use for the treatment of animals. Of this quantity 3,568,687 cubic centimeters was derived from animals affected with diseases such as tuberculosis, pneumonia, septicemia, etc., and the re-

maining 5,791,609 cubic centimeters was destroyed because of contamination in the process of manufacture or on account of other conditions which rendered the product unfit for use. The total amount of simultaneous virus destroyed was 2,035,096 cubic centimeters, of which 533,416 cubic centimeters was destroyed on account of being derived from diseased animals and 1,501,680 cubic centimeters because of contamination and other undesirable conditions. The total quantity of hyperimmunizing virus destroyed was 3,174,242 cubic centimeters, of which 2,753,075 cubic centimeters was destroyed on account of disease and 421,467 cubic centimeters on account of contamination and similar conditions.

EXPORTATION OF BIOLOGICAL PRODUCTS

The exportation of biological products continued to increase. Three hundred and forty-one certificates were issued to accompany shipments to 25 foreign countries.

PATHOLOGICAL DIVISION

The Pathological Division, under the direction of John S. Buckley, chief, continued as its main activities the scientific investigation of animal diseases, the testing of biological products manufactured and marketed under Federal control, and the study of plants poisonous to livestock.

RESEARCH ON DISEASE PROBLEMS

BOVINE INFECTIOUS ABORTION

In continuation of the study of bovine infectious abortion, repeated tests were made on a few herds where it was possible to separate the animals into reacting and nonreacting groups which could be maintained as separate units. The results indicated that in herds of long-standing infection it is possible and frequently practicable, through the use of the agglutination test, to eliminate the carriers of the disease and thereby establish an abortion-free herd, but it is doubtful whether the same procedure can be applied with an equal degree of success in herds of more recent infection, where frequent tests indicate that the malady is being more or less rapidly disseminated.

The division, cooperating with four State laboratories, conducted agglutination and complement-fixation tests with duplicate samples of blood serum with the idea of accounting for the

conflicting results that have sometimes been obtained by different laboratories when blood serum from the same animals has been submitted for diagnosis. The progress made indicates that the procedure will result in the development of a more nearly uniform method of applying the tests and in their interpretation.

Studies to determine the practicability of immunization against this disease were continued. Following previous work showing that a considerable degree of immunity was conferred by the use of living abortion organism vaccine on unbred heifers about two months before breeding, an experiment was begun to determine whether similar results may be obtained by the vaccination of heifers when they are only 5 or 6 months old.

Other experimental work was directed toward overcoming *Bacterium abortus* infection of the udders of cows by the use of abortion bacterin and also by inflation of the udders with chloroform fumes. The former work has been prepared for publication, and the latter is still in progress.

SOURCE OF TUBERCULOSIS IN SWINE

As apparently tuberculous lymph glands were found in numerous hogs marketed from counties in which all the cattle had been subjected to the tuberculin test and all reactors removed, and as this infection in hogs was suspected to have been contracted largely from tuberculous fowls, extensive tests were undertaken to determine the type of infection in such cases.

Lymph glands with lesions resembling those of tuberculosis from 481 hogs were tested, each by inoculation into one guinea pig and one hen. In about 29 per cent of the cases positive results were produced in the guinea pigs, indicating that the diseased glands were affected with tubercle bacilli of mammalian origin. Lesions resembling tuberculous growths were produced in fowls alone by about 15 per cent of the glands, and these cases may be classed as having been caused by avian tubercle bacilli. About 10 per cent of the hog glands caused tuberculous lesions in both guinea pigs and hens, indicating mixed types of tubercle bacilli. Nearly one-half of the hog glands failed to cause the development of any lesions in the test animals.

By comparative tests in the application of the tuberculin test to the hens 60 days after the injection of the emulsion of tuberculous hog gland, it

was found that results quite as reliable, if not more accurate, can be obtained by using the bureau tuberculin prepared for intradermic use on cattle as from the use of avian tuberculin made from cultures of avian tubercle bacilli.

HEMORRHAGIC SEPTICEMIA

Further studies of hemorrhagic-septicemia aggressin were made. Earlier experiments had shown that this product is capable of producing a high-grade immunity against hemorrhagic septicemia of domestic animals. The studies of the past year provided the additional information that animals treated with hemorrhagic-septicemia aggressin acquire an increased resistance to infection at a very early date. Animals so treated were found to be immune to artificial exposure as early as four days after vaccination, whereas animals treated with hemorrhagic-septicemia bacterin in the same experiments were immune only after the ninth day. Aggressin-treated cattle were further found to be still resistant to infection 15 months after vaccination. The rapidity with which the immunity is produced, together with its long duration, warrants the conclusion that hemorrhagic-septicemia aggressin is a valuable veterinary biological product. Its production on a commercial scale seems to be practicable.

OTHER RESEARCH STUDIES

A chronic form of pneumonia, the so-called "progressive pneumonia" of sheep, which is quite prevalent in Montana, was studied with the view of ascertaining the cause. Several different types of organisms were isolated from the cases examined, and one is thought to be a possible causative factor. Further work will be done in an effort to reach definite results.

In continuation of studies on vaccination against rabies in dogs experiments are in progress to determine definitely whether there are strains of rabies street virus which have inherent differences other than that of virulence.

Much work was done on the toxin isolated from *Ascaris lumbricoides* (roundworm of hogs) in cooperation with the Zoological Division. Many extracts of ascaris and of other parasites were prepared for the use of an outside scientist in studying the precipitin reaction. A paper describing the sensitivity to ascaris toxin and some chemical characters of the toxin was published.

DIAGNOSIS AND CONTROL OF DISEASES

RABIES

The number of cases examined for rabies shows an increase over the two preceding years, indicating a probable lack of enforcement of muzzling orders. Specimens from 151 suspected cases were received and submitted to laboratory examination, with positive results in 125 cases, while in 1 case decomposition prevented a diagnosis. The positive cases consisted of 110 dogs, 10 cats, 4 cattle, and 1 horse. A considerable number of persons as well as a number of dogs had been bitten by the affected animals. In every instance in which a person had been bitten laboratory animal inoculations were made when the microscopic findings were negative.

Most of the cases came from the District of Columbia and adjacent portions of Maryland and Virginia, but there were isolated cases from more distant States, as West Virginia, North Carolina, Kentucky, and Tennessee.

Contrary to the popular idea that rabies is a disease of the hot "dog days" of summer, it is noted that 57 of the 151 suspected animals were brought to the laboratory during December, January, February, and March.

TUBERCULOSIS

Specimen tissues from 132 cattle that had reacted to the tuberculin test but had shown no visible lesions of tuberculosis on autopsy were submitted for laboratory examination. By microscopic examination, in some cases accompanied by animal inoculations, the presence of tubercle bacilli was demonstrated in 51 of the samples, whereas 81 gave negative results.

GLANDERS

The complement-fixation test was applied to samples of blood serum from suspected cases of glanders submitted by State officials and practicing veterinarians. Seventy-three such samples were tested, of which 10 gave positive results and 3 were indecisive.

DOURINE

In the course of the campaign for the control and eradication of dourine, 5,720 samples of blood serum from horses in regions where the disease exists were subjected to the complement-fixation test, with positive results in 297 cases.

TRYPANOSOMES OF CATTLE

By cultural methods it was determined that 17 out of a lot of 26 cattle were harboring in their blood *Trypanosoma americanum*, a nonpathogenic trypanosome. The serums of all these cattle gave negative results to the complement-fixation test for trypanosomiasis with antigen prepared from *Trypanosoma equiperdum*, indicating that the presence of nonpathogenic trypanosomes is not detectable by the use of antigen from the pathogenic species mentioned.

DISEASES OF POULTRY AND OTHER BIRDS

In connection with the bureau's work of combating the epizootic of European fowl pest already mentioned, the Pathological Division conducted laboratory investigations of the disease and cooperated in diagnosing cases in the various States in which it appeared.

An investigation was also made of an infectious bronchitis of poultry which raged for several months in large fattening stations in the Middle West.

In the study of bird diseases many chickens and other birds were subjected to autopsy. The infectious conditions encountered were principally bacillary white diarrhea and coccidiosis in young birds and aspergillosis, blackhead, cholera, diphtheria, infectious bronchitis, leukemia, pest, pox, roup, tuberculosis, and typhoid in birds of varying ages. Aside from numerous autopsies of specimens from the National Zoological Park, the principal species examined were chickens, turkeys, geese, pigeons, quail, chipping sparrows, and canaries.

Expert testimony was given in legal proceedings instituted by the Bureau of Chemistry and the Insecticide and Fungicide Board against manufacture of poultry remedies.

Farmers' Bulletin 1337 on diseases of poultry was revised and reprinted.

TESTING BIOLOGICAL PRODUCTS

The testing of commercial veterinary biological products produced under Government licenses, as well as of the cultures from which they were prepared, was continued with samples collected by the Division of Virus-Serum Control in connection with the enforcement of the virus-serum-toxin law. Samples of 45 products were tested, of which 15 were found to be unsatisfactory because of lack of potency or by reason of contamination.

One hundred and fourteen cultures were also examined, and eight were found to be unsatisfactory.

INVESTIGATION OF POISONOUS PLANTS

The investigations of poisonous plants and their effects on livestock were continued on the same general plan as in preceding years. Field experiments are conducted mainly at the Salina Experiment Station near Salina, Utah, while most of the laboratory studies are carried on at Washington.

CHEMICAL STUDIES

Chemical studies of poisonous plants, with the object of isolating and identifying the poisonous principles and determining their nature, were continued with several species.

Work on loco plants has narrowed the active agent down to a comparatively pure fraction and has eliminated from consideration practically all the well-known classes of poisonous substances. It appears that the toxic agent may represent an entirely new class of poisons. Further experiments to solve this question are in progress.

A number of species of lupine were studied. Dextrolupanin was isolated from *Lupinus kingii* and identified as identical with the alkaloid previously found in *L. polyphyllus*, *L. albus*, and *L. angustifolius*. A paper reporting this work is in press. The alkaloids were extracted from *L. perennis*, *L. sericeus*, *L. leucophyllus*, *L. decumbens*, and *L. luteolus*. A paper on certain phases of this work has been published and another is awaiting publication.

In studies of two species of milkweed *Asclepias eriocarpa* was found to contain but one active constituent, which was isolated and is being purified for exact chemical study, while this constituent was not found in *A. galioides*, though other poisonous substances were extracted from the latter plant for further study.

Progress was made also in chemical studies of *Eupatorium*, *Isocoma*, and *Baccharis*.

FIELD INVESTIGATIONS OF POISONOUS PLANTS

Feeding experiments showed conclusively that the loco plant *Astragalus allochrous* produces loco effects on cattle, sheep, and probably horses. *A. nothoxys* and *A. thurberi* were also found to produce loco poisoning in cattle. These results place these three species definitely among the loco plants.

Further work on three species of milkweed showed that *Asclepias fremontii* and *A. vestita* are poisonous to sheep, but that *A. cordifolia*, a species growing on the California ranges, is not dangerous to livestock.

As dogbane (*Apocynum ambigenum*) was found on areas where cattle had been poisoned, a series of feeding experiments with this plant was made on both cattle and sheep. The results showed, without any reasonable doubt, that it is not a stock-poisoning plant.

Work on coyotillo or rubber weed, *Hymenoxys richardsonii* (*H. floribunda*, *H. ligulacifolia*), showed conclusively its poisonous character and that its harmful effect is not connected with the "rubber" secreted by the plant.

Another plant also known as coyotillo (*Karwinskia humboldtiana*) was tested in experiments on cattle, sheep, and chickens. This plant produces a lumbar paralysis from which recovery is very slow; in fact, most animals die. It is especially poisonous to cattle, less so to sheep, and still less to chickens. The poison is cumulative. These results were obtained by feeding the fruit. Experiments in feeding the leaves were begun, but are not completed.

Following previous work on *Isocoma wrightii*, two other species (*I. coronopifolia*, a plant growing in New Mexico and Arizona, and *I. heterophylla*, considered by some botanists as identical with *I. wrightii*) were tested, and results so far obtained indicate that both produce the same poisonous effect as the first-named species. Besides losses of livestock, *Isocoma* plants have indirectly caused loss of human lives through the use of milk of poisoned cows.

Experiments with a wild tobacco (*Nicotiana trigonophylla*) growing in New Mexico showed that it is poisonous, and knowledge obtained from field investigations make it evident that it has been the cause of considerable losses.

Incomplete results of experiments with *Senecio integerrimus* and *S. spartioides* indicate that both of these species under certain circumstances will produce poisonous effects. Other species of *Senecio* have long been known to be poisonous.

"Sleepy grass" (*Stipa vaseyi*) has been under investigation for a long time, but clear-cut and definite results were obtained for the first time in

1924. Definite cases of poisoning of horses were produced by feeding it.

Feeding experiments on sheep proved that the fruit of a suspected plant, *Symphoricarpos vaccinoides*, is harmless.

The loss of about 100 cattle at Delta, Utah, supposed to be due to feeding hay that had been sprayed with calcium arsenate, was found on investigation to be due to malnutrition.

A revised edition of the bulletin on "Stock Poisoning Plants of the Range," with numerous illustrations, some in color, was issued as Department Bulletin 1245. A new publication reporting results of investigations of cockleburs (species of *Xanthium*) was issued as Department Bulletin 1274.

BRANCH LABORATORIES

The branch pathological laboratory at Chicago, Ill., conducted investigations of diseases in meat food animals similar to those of previous years, consisting principally in making diagnoses of diseased conditions in animals slaughtered in establishments operating under Federal meat inspection. Cooperation was extended to the Chicago health department as well as to some of the local medical colleges and hospitals.

Numerous reports of the presence of European fowl pest on farms in Illinois were investigated and many diseased fowls sent to the laboratory were examined, but outside of Chicago the disease was found only in a small flock of chickens at Joliet, Ill. In Chicago the disease was found in poultry cars returned from eastern markets on account of embargoes and in some small flocks kept within the city limits. Filtration tests showed that the disease was caused by a filterable virus.

The branch laboratory at South Omaha, Nebr., examined 772 specimens, of which 484 were from tuberculin reactors which showed no lesions on post-mortem examination. Of these reactor specimens 172 were positive and the remainder negative. Tuberculous infection was found in 38 specimens of cervical lymph glands of hogs from accredited areas and coccus or other pus infections in 39 similar specimens. There were several cases of skin infection with tuberculosis. Fowl tuberculosis was found in 20 cases, neoplasms in 33, and parasitic infestations in 9. The remaining

specimens included 19 cases of pasteurellosis, 6 of actinomycosis, 5 of fowl cholera, and 2 of chronic bipolar arthritis in fowls, besides other miscellaneous conditions.

The branch laboratory at Denver, Colo., received for laboratory examination specimens ranging from 150 to 200 a month and representing a great variety of subjects. All the domesticated species of animals were represented, as well as several wolves and foxes. The diseases found included anthrax, blackleg, malignant edema, hemorrhagic septicemia, hog cholera, blackhead of turkeys, and many other ailments of a less serious nature.

An obscure disease of sheep, principally lambs fattening on pea vines in certain western regions, has been investigated by various workers in recent years. Work done this year at the Denver laboratory indicates almost certainly that these losses have been caused by infection with anaerobic organisms that gain entrance into the tissues through the agency of rough pea vines or by plants that have thorns or prickly parts that injure the soft tissues of the mouth and permit the implantation of the germs that produce intoxication and death of the sheep. The organism is known as *Clostridium septicum*. A paper has been prepared giving the details of this investigation.

BIOCHEMIC DIVISION

The work of the Biochemic Division, under M. Dorset, chief, consisted chiefly of laboratory research relative to meat products, investigations concerning hog cholera, studies of dips, disinfectants, and insecticides, and the preparation of tuberculin and mallein.

Much of the research work is too technical to be described in this report, but the results are reported from time to time in technical publications.

INVESTIGATION OF MEAT AND MEAT FOOD PRODUCTS

The chemical studies of meat and meat food products were continued, a part of the work being carried out in cooperation with the Animal Husbandry Division.

VITAMIN A IN MEAT AND MEAT PRODUCTS

The work on the vitamin A content of oleo oil and oleostearin was continued, and the results were prepared for publication. It was found that the

lighter-colored grades of oleo oil (Nos. 1, 2, and 3) contained a fair amount of vitamin A and that the so-called yellow oleo oil prepared from the fatty tissues of grass-fed cattle was much richer in this vitamin than the other grades of oleo oil which were subjected to examination. Oleostearin was found to be decidedly poorer in vitamin A than the corresponding grades of oleo oil, but yellow oleostearin contained a fair amount of this vitamin.

In continuation of the study of vitamin A in edible viscera it was found that ox brains and ox spleen contain a fair amount of vitamin A, though not nearly so much as has been found in ox liver and ox kidney.

The study of the vitamin A content of poultry flesh and fat was continued in cooperation with the Animal Husbandry Division. The flesh and fat of chickens, ducks, geese, turkeys, and guinea fowl were examined. There was found to be a wide variation in the amount of vitamin A present in both the flesh and the fat from the several species of fowl and even in different lots of flesh and fat from the same species. These variations are undoubtedly due to corresponding variations in the vitamin A content of the diet of the birds.

VITAMIN REQUIREMENTS OF SWINE AND LAYING HENS

The liver, muscle tissue, and fat from two lots of pigs were tested for vitamins A and B. It was found that the concentration of vitamin A in the livers and vitamin B in the livers and muscle tissues of the pigs was greatly influenced by the vitamin content of the diet, particularly when the same ration had been fed to the mother of the pigs for some time before and during gestation and lactation. Although it is generally considered that animals can not store any appreciable quantity of vitamin B, the results of these experiments indicate that the hog at any rate possesses this function to a marked degree.

In continuation of the study of the vitamin requirements of laying hens it was found in general that the vitamin A content of the eggs as well as of the flesh of hens was materially affected by the amount of this vitamin in the rations. The relationship of vitamin in the rations to vitamin in the eggs and flesh of the hens was not so regular as might have been expected.

NUTRITIVE VALUE OF PROTEINS IN
ANIMAL TISSUE

A study of the nutritive values of the proteins in the voluntary muscle, heart, liver, and kidneys from cattle, sheep, and hogs, and in veal, sweetbreads, beef cheek meat, ox lips, ox tongues, ox brains, ox spleens, and tripe, as well as in hog brains and hog tongues, was completed. Without going into detail, which will be furnished in papers submitted for publication, it may be stated that with the exception of the protein in tripe, sweetbreads, beef cheek meat, and ox lips the protein in the several tissues had practically the same value, which was as high as that obtained for the total protein in milk. The protein from tripe, sweetbreads, beef cheek meat, and ox lips was found to have considerably lower nutritive values than that in the other tissues when a single tissue constituted the only source of protein in the diet. Investigations to determine the nutritive values of the protein in the following products are in progress or have been completed: Gelatin, meat extract, ox palates, cracklings, blood, serum proteins, hemoglobin, and hog snouts.

A study is also being made of the supplementary values of the proteins in different animal tissues, particularly combinations of a tissue containing protein of good quality with one containing protein of poor quality. In several instances such mixtures of animal proteins have been found to have practically as high nutritive values as an equal quantity of the better protein.

RANCIDITY OF FATS

The work on rancidity of fats was continued, attention being directed more especially to an investigation of the physiological effect of rancid fats. As a result of experiments with white rats it appeared that rancid fats, without being actually toxic in themselves, produced vitamin A deficiency as a result of their activity in destroying the vitamin A in the rations to which the rancid fats were added. A paper embodying the results of this work is in course of publication. The fundamental investigation of the compounds responsible for the typical odor, flavor, and chemical reactions of rancid fats progressed and are being continued.

INVESTIGATIONS OF DIPS AND DISINFECTANTS

Routine laboratory work involved the examination of 234 samples of dips, disinfectants, serums, viruses, and related products. Most of the samples of disinfectants were forwarded by bureau employees in the field to insure that manufacturers of permitted products were adhering to the required standards. On the whole, this class of products was found to be of generally satisfactory quality.

FIELD TESTS FOR DIPPING BATHS

During the calendar year 1924 the laboratory prepared and forwarded to inspectors in the field, for testing the strength of dipping baths, 503 new test outfits for arsenical dips and supplies sufficient to make 388,480 field tests, 34 new test outfits for lime-sulphur dips and supplies sufficient to make 7,900 tests, and 10 new outfits for testing nicotine dips and supplies sufficient to make 3,770 tests.

SAPONIFIED CRESOL SOLUTION

The investigations of saponified cresol solution mentioned in last year's report were completed and the results submitted for publication. It was found not only that saponified cresol solutions prepared with coconut-oil soap have a greater germicidal efficiency than similar solutions prepared with linseed-oil soap, but that the coconut-oil soap itself has greater germicidal efficiency than linseed-oil soap. In fact, the soap alone has a fairly high efficiency against *Bacillus typhosus* and *B. pyocyaneus*, but it has little or no efficiency against *Staphylococcus aureus* and *B. tuberculosis*. The extensive bacteriological work, together with the development of more adequate methods for testing the physical properties of samples, has made it possible to relieve manufacturers from the previous requirement that the soap in saponified cresol solution should be derived only from linseed oil or soy-bean oil. By leaving the manufacturer free to select an appropriate soap base, it is believed that the user may obtain a product in no wise inferior at somewhat less cost. This change in regulation is embodied in B. A. I. Order 292.

PROPERTIES OF SOAP SOLUTIONS

As a part of the investigation respecting the germicidal activity of soap and of mixtures of cresol with soap, considerable attention was given to a study of the mechanism by which soap affects both the microorganisms and the cresol. This study of the properties of soap solutions has led to what appears to be a theoretically sound and practically feasible method for a laboratory determination of the relative detergent efficiencies of various soaps in water of varying hardness. A paper describing a part of the work has been published, and further data are being prepared for publication.

MODE OF ACTION OF DISINFECTANTS

In the study of the mode of action of disinfectants, continued from the preceding year, bacteriological work with the primary alcohols from methyl to octyl, inclusive, was completed, using *Staphylococcus aureus* and *Bacillus typhosus* as test organisms. The results indicate that there is a definite ratio of bactericidal efficiency between the different members of this series of alcohols. Work with the secondary and tertiary alcohols is being continued. A series of parallel tests with phenols has been carried along during the study of alcohols.

TUBERCULIN AND MALLEIN

The production of tuberculin and mallein for official use by bureau and State inspectors was continued. The demand for mallein remained comparatively small, the total amount supplied being 25.095 doses, an increase of approximately 12 per cent over the preceding year. The demand for tuberculin, however, continued to increase. Although the subcutaneous test is used less than in former years, the decrease in the demand for that form of tuberculin is more than offset by the greatly increased use of the intradermic and ophthalmic tests. The year's output of tuberculin was as follows: Subcutaneous tuberculin, 614,820 cubic centimeters, a decrease of about 18 per cent from the preceding year; intradermic tuberculin, 12,538,170 doses, an increase of about 33 per cent; ophthalmic tuberculin, 3,283,560 disks, an increase of about 36 per cent. In terms of doses the total production amounted to 14,300,000 doses.

The demand for tuberculin has about reached the capacity of the

present laboratory incubators and equipment. Plans have been made for remodeling the incubators and for the installation of certain labor-saving and time-saving devices which it is believed will enable the laboratories to meet any normal increase in the demand during the coming year without increasing the personnel. By the use of economical methods and devices, as well as from the increased skill resulting from experience of employees, the cost of tuberculin per dose was reduced from 0.3 of a cent in 1923 to 0.22 of a cent in 1925.

The study of the metabolism of tubercle bacilli begun in the last fiscal year was continued. A good deal of work was also devoted to a chemical study of tuberculin, the object being if possible to isolate and identify the active principle. The results of this work have been submitted for publication. About 40,000 doses of a special tuberculin were prepared and furnished to the Tuberculosis Eradication Division for experimental tests.

HOG-CHOLERA INVESTIGATIONS

The study of the immunization of suckling pigs against hog cholera, in cooperation with the Animal Husbandry Division, was continued. In the fall of 1924 tests of the immunity of pigs which had been treated by the simultaneous method in the spring of that year did not give the uniformly satisfactory results observed in previous years. On several farms the pigs tested in the fall of 1924 were found not to possess the high degree of immunity which had previously been observed. It is not clear why pigs on certain farms, and in this year in particular, should have failed to acquire the immunity which was conferred on pigs on other farms and on these farms in previous years. An experimental study of this question is under way.

Earlier promising experiments to test the effect of formaldehyde as an attenuating agent for the virus of hog cholera were repeated. The second and third series were not so successful as the first. The experimental pigs in the later work all remained well after treatment, but did not acquire immunity. It appeared, therefore, that the formaldehyde as applied to these later lots had resulted in either the complete destruction of the virus or else too great an attenuation to produce a subsequent immunity. In view of the success attained in the beginning of this work, some further experiments are being carried out.

The reported success of the German investigators Dahmen and Frosch in the cultivation of the virus of foot-and-mouth disease led the Biochemic Division to apply similar methods to the virus of hog cholera, but in no case was there any indication whatever of microbic growth.

A considerable quantity of anti-hog-cholera serum was produced for the experimental work and for the immunization of pigs on various farms of the department. Certain commercial serums and reputed cures for hog cholera were tested, and hog-cholera virus was furnished to serum-producing establishments on request. In order to determine the keeping qualities of anti-hog-cholera serum, two serums respectively 6 and 7 years old were tested for potency, and both were found to be apparently as potent as when first produced.

HOG "FLU" INVESTIGATIONS

The study of hog "flu" was continued whenever opportunity presented itself. Specimens and cultures were obtained from several herds. It was found that the disease may be readily transmitted to healthy hogs by dropping into the nose a suspension of tracheal mucus obtained from a sick pig. Typical "flu" symptoms result from such treatment, and in this manner the disease was carried through a number of generations. It was also observed that the disease was transmitted readily from sick to well animals by contact exposure and that the nasal secretion was capable of transmitting the disease as well as the tracheal and bronchial secretions. A large amount of bacteriological work was done on the infected pigs and a number of different microorganisms were isolated. Although tracheal mucus produced the disease so readily, the filtered suspensions of mucus were found to be without effect; likewise pure cultures from the tracheal mucus usually failed to produce any effect upon the exposed pigs. It thus appears that none of the microorganisms isolated can be regarded as the primary cause of this disease.

During the course of these investigations *Bacillus pyogenes* was isolated from sick pigs in two herds. This microorganism, which is recognized as an important disease producer, failed to give rise to any symptoms when suspensions of pure cultures were dropped into the noses of healthy pigs. When these pure cultures were injected intravenously, however, they caused multiple abscesses in the lungs

and purulent arthritis involving the hock joints of both hind legs.

In connection with the bacteriological study of the trachea and lungs of hogs affected with "flu" a special study of the normal bacterial flora of healthy pigs was undertaken.

COOPERATION WITH INSECTICIDE AND FUNGICIDE BOARD

The routine examination of samples for the Insecticide and Fungicide Board was continued, and the bureau furnished to that board expert advice on veterinary, chemical, and bacteriological subjects.

ZOOLOGICAL DIVISION

The investigation of parasitic diseases of animals and the study, collection, and determination of animal parasites were continued in the Zoological Division under the direction of B. H. Ransom, senior zoologist and chief of the division.

ROUNDWORMS AND OTHER INTERNAL PARASITES OF SHEEP

At the experimental farm at Vienna, Va., the results of experiments in controlling stomach worms of sheep by means of medicinal treatment were very similar to those obtained in former years. Satisfactory control has been accomplished by periodical dosing of the flock with 1 per cent copper-sulphate solution with or without the addition of nicotine sulphate. The results of treatment with the double sulphate solution have apparently been superior to treatment with copper-sulphate solution alone. A mixture of powdered arsenic and copper sulphate administered periodically in individual doses prevented losses from stomach worms, and the lambs remained in good condition, although the parasites persisted in the experimental animals in varying numbers throughout the experiment. A mixture of tobacco dust and salt to which sheep in one pasture were given access failed to prevent serious losses from stomach worms, although it apparently controlled tapeworm infection.

In the control of tapeworms the copper-sulphate and nicotine-sulphate mixture has shown some effect, as has also a 1½ per cent solution of copper sulphate. The safety of the latter (which is 50 per cent stronger than the usual 1 per cent solution) is, however, questionable.

In October, 1922, an investigation was begun in Schuyler County, Mo., for the purpose of determining the

results of periodical treatment of farm flocks of sheep with a 1 per cent solution of copper sulphate, a method of treatment which had given good results in the control of stomach worms at the Vienna farm. The treatment has been given regularly every 25 to 28 days, except during January, February, and March, to the flocks on a number of farms whose owners have been cooperating in the experiment. On July 1, 1924, there were in the experiment 2,155 sheep and lambs on 11 farms, and on June 30, 1925, 2,009 sheep and lambs on 10 farms, one co-operator having dropped out. At the beginning of the experiment in 1922 all owners reported that they had experienced serious losses and injury from stomach worms. During the experiment no change has been made from the former usual practice of grazing, which consists in the use of permanent pasture throughout the year, except in the fall, when the flocks are allowed to run in fields and meadows from which the crops have been removed. During the last year none of the sheep or lambs under treatment were seriously injured by stomach-worm disease. Tapeworms were not seen, although present in several of the flocks in 1922 when the experiment began. Nodular worms, however, continue more or less in all the flocks, in one flock causing the death of two yearlings and one aged ewe, but in general not seriously affecting the health of the flocks. Lung worms were present in one flock but affected seriously only five late lambs. Intestinal roundworms other than nodular worms persisted, but in numbers insufficient to cause serious damage except to an occasional animal. The death losses from all causes have been much reduced in the flocks since the copper-sulphate treatment was instituted. The second generation of sheep which have developed under the copper-sulphate treatment are larger than their dams, have grown better wool, and when marketed have sold without culls. Buyers of feeder lambs from the dosed flocks have recognized their outstanding condition and paid top prices for them. These lambs have done well on feed and have made rapid gains. The owners of the flocks are unanimous in stating that they have had much better results in raising sheep with the copper-sulphate treatment than without.

ROUNDWORMS OF SWINE

The experiments on the control of roundworms and associated filth-borne diseases of young pigs were continued in McLean County, Ill., 9,000 pigs on 20 farms being utilized in the experiments. The results have been as successful as those of former years. Based on the results of the experimental work in McLean County the extension service of the University of Illinois has inaugurated a project of swine sanitation in cooperation with local farm bureaus, under which demonstration work is being carried out on more than 600 farms in about 60 counties. Similar agencies in Iowa, Nebraska, and other States are also actively engaged in establishing the sanitation method of rearing pigs that was devised in this bureau. The experience of numerous Corn Belt swine raisers who have practiced this method shows that they can rear as many pigs as formerly with two-thirds as many brood sows, that death losses and runts caused by worm and hog-lot diseases are almost entirely avoided, that the pigs grow and develop more evenly, and they are ready for market from a month to six weeks earlier than under usual methods of management.

Various experiments bearing on this project were carried out during the year. In one it was found that pigs kept exclusively on clean clover pasture gained more rapidly than others of the same age on similar pasture with access to a wormy hog lot, in the former instance reaching an average weight of 218 pounds, and in the latter only 162 pounds. In another experiment pigs on pasture with access to a permanent hog lot also failed to make good gains in weight, and those that were found at slaughter to be infested with the largest numbers of worms were those that weighed the least. In an experiment in which *Ascaris* eggs were exposed to the weather on top of the soil at Chicago, Ill., from October to June, 231 days, the eggs were found to have survived, but not to have progressed beyond an early stage of development. When moisture was added the contained embryos soon developed to the infective stage. Attempts to immunize animals against *Ascaris* infection by means of repeated injections of fluid from the body cavity of the worms were failures. Further experiments are in

progress with reference to the question of the transmissibility of the *Ascaris* of human beings to pigs.

TREATMENT AND CONTROL OF EXTERNAL PARASITES

Although work in the treatment and control of external parasites was seriously interfered with by foot-and-mouth disease outbreaks, some progress was made.

Experiments on the control of ox warbles by the use of wading tanks were continued. Range and dairy cattle were used as experimental animals. These cattle were required to wade daily through shallow tanks containing fluid enough to wet the legs as high as the knees and hocks. Coal-tar-creosote dips, pine-tar emulsions, crude petroleum, or a mixture of oils was mixed with or floated on water in the wading tanks. The wading-tank treatment failed to eradicate warbles, but cattle subjected to the treatment were found to have few warbles the following season compared with untreated animals. Processed crude-petroleum and coal-tar-creosote dips (freshly diluted) proved to be the most effective remedies. In the case of coal-tar-creosote dips frequent recharging of the tanks was necessary, owing to the deterioration of the diluted dip with use.

Field trials are in progress at various locations in the range area to determine the effects of dry lime-sulphur dip as a remedy for scabies of cattle and sheep.

TESTS OF ANTHELMINTICS

A series of tests with chlorinated hydrocarbon compounds was made with a view to correlating the anthelmintic efficacy with the chemical composition. These tests have developed the fact that, so far as can be judged from tests on dogs, tetrachlorethylene is apparently at least as good as carbon tetrachloride for the removal of hookworms and may even be somewhat better. The drug has been brought to the attention of veterinarians and physicians for further study and test. Carbon tetrachloride, proposed by this division in 1921 as a drug for the removal of hookworms, has now been used in more than 1,500,000 human cases and is in world-wide use in human and veterinary medicine.

Tests have shown that the degree of water solubility is probably also a factor in anthelmintic efficacy. The

optimum solubility appears to be about 1 in 1,250; substances distinctly more soluble are too toxic, owing to high absorption, and substances distinctly less soluble are ineffective, owing to the unavailability of the anthelmintic constituents.

A flock of sheep was treated with carbon tetrachloride 14 times in the course of a year. The treatment was highly effective in controlling stomach worms, small trichostrongyles, nodular worms, and whipworms, and the sheep made excellent gains under treatment.

Numerous anthelmintic investigations were carried out, mostly with negative results. Preliminary experiments to ascertain a dependable treatment for tapeworms in poultry, something for which there is a great demand, indicate that a satisfactory treatment can probably be developed in an extension of the work, which is being continued.

MISCELLANEOUS INVESTIGATIONS ON ANIMAL PARASITES

Studies on bird nematodes resulted in the preparation of a monograph of these worms, exclusive of the filarids and trichurids, and in the publication of a revision of the gapeworms. The common intestinal roundworm of American chickens has been shown to be *Ascaridia lineata* and not *A. perspicillum* as heretofore believed.

Investigations of cattle ascarids in the United States have shown for the first time the presence of *Ascaris vitulorum* in American cattle. *A. lumbricoides*, the human and swine ascarid, not heretofore known to occur in cattle, has been discovered in American cattle. *A. vitulorum* is known to be distinctly pathogenic for calves, and further investigations are being made in regard to this parasite in the United States. A publication on the parasites and parasitic diseases of the dog, for which there has been considerable need, was issued.

Miscellaneous published studies include tests of miscellaneous anthelmintics; a study of carbon trichloride as an anthelmintic; a test of raw onions as a control measure for worms; tapeworms as the cause of losses among American geese; the first report of a tapeworm, *Bertiella delafondi*, from American pigeons; new nematodes from the cat, the zebra, and the bison; studies of nematodes from Tonkin, French Indo-China; and early stages in the life history of the cattle hookworm.

EXPERIMENT STATION

The general character of the work of the Experiment Station at Bethesda, Md., under E. C. Schroeder, superintendent, was similar to that of previous years, and comprised independent investigations of the infectious diseases of the lower animals; studies of various foods derived from animals with regard to their possible contamination with disease germs; tests of the value of alleged remedies for and immunizing agents against infectious diseases of animals; investigations in cooperation with other scientific divisions; and the provision of facilities for other divisions to make investigations under normal farm conditions.

BOVINE INFECTIOUS ABORTION

The study of bovine infectious abortion was continued throughout the year. The favorable results reported last year, obtained through the use of relatively simple control measures in privately owned and maintained herds, have continued, and little doubt remains that such measures, where they can be scrupulously and unfailingly carried out, are profitable and effective. In view, however, of the insidious character and the wide prevalence of the disease and of the great difficulty of preventing and overcoming the infection, it seems that general relief from the evil will depend upon a definite means of immunizing against it or a specific treatment for it. With this object in view, many studies and tests with abortion vaccines and bacterins were made, but they have not yielded results which can be presented at this time.

TUBERCULOSIS

Several alleged cures for and methods of immunizing against tubercu-

losis were tested, and, with the exception of one method of producing immunity, the studies on which are not yet complete, were found to be unsatisfactory. A definite conclusion regarding this method probably can not be reached for at least another year.

The periodic tests of the purity and potency of tuberculins produced and marketed in the United States under Federal license revealed several samples either lacking in potency or contaminated with an excessive number of dead tubercle bacilli. Measures were taken at once for the withdrawal of the unsatisfactory material from the market.

The examination of samples of dairy products for tubercle bacilli indicated that this dangerous contamination has become very rare in such products in general commerce, probably because of the greatly increased use of pasteurization.

MISCELLANEOUS INVESTIGATIONS

A number of minor investigations were conducted, one concerning the disease known as equine vesicular stomatitis. The lesions of the disease so closely resemble those of foot-and-mouth disease that often it is difficult to distinguish between them. Past tests which indicated that the disease is not due to a filterable organism were repeated and former results confirmed. Attempts to grow the probably responsible organism failed but are being continued.

Available land was utilized to the fullest extent in growing forage for experiment animals. A large number of small experiment animals were raised.

REPORT OF THE CHIEF OF THE BUREAU OF DAIRYING

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF DAIRYING,
Washington, D. C., August 1, 1925.

SIR: I submit herewith a report of the work of the Bureau of Dairying for the fiscal year ended June 30, 1925.

Respectfully,

C. W. LARSON,
Chief of Bureau.

Hon. W. M. JARDINE,
Secretary of Agriculture.

In accordance with an act of the Sixty-eighth Congress, approved May 28, 1924, there was established in the Department of Agriculture, July 1, 1924, a Bureau of Dairying. The activities of the bureau previous to that date were conducted by the Dairy Division of the Bureau of Animal Industry. By direction of the Secretary the personnel and equipment formerly engaged in the work of the Dairy Division were transferred to the new bureau. Through the courtesy of the Bureau of Animal Industry the accounts and personnel activities were carried by that bureau until our new organization was established to handle such matters.

In order to carry out the policy of enlarging the work in fundamental research it was necessary to readjust the activities by cutting down the force devoted to cooperative work in the States, in order that new investigational activities might be undertaken, since no additional funds were available to the new bureau. Work in nutrition and breeding of dairy cattle was considerably enlarged. The new building for nutritional studies was put into use and will greatly facilitate these important studies.

The dairy farm at Beltsville, Md., was enlarged through the purchase of an additional 129 acres of land in May, 1925. Experience has shown that with so large a herd as it is necessary to maintain in order to conduct properly the investigations in breed-

ing, nutrition, management, and dairy sanitation, it is distinctly economical to produce our own alfalfa hay and corn for silage. However, the land that was heretofore available for the production of these crops could scarcely produce the quantities required to feed the herd. Some pasture seems necessary, and a portion of the land must necessarily be devoted to the growing of other crops which are essential to certain studies. The additional acreage which was recently acquired will greatly facilitate our studies in milk production.

The funds provided by the agricultural appropriation act for the Bureau of Dairying for the fiscal year 1926 are practically the same as for 1925; consequently there can be no substantial expansion of our research activities during the next fiscal year. Later, however, it is hoped that it will be possible to undertake new lines of research and to broaden the scope of some of our current projects. More investigational work is needed in connection with the feeding and breeding of dairy cattle. The average production of the American dairy cow is still much too low; and cows of low production are not economical. Studies of the fundamental problems of breeding, nutrition, and milk secretion should therefore be materially enlarged. The manufacture of products and by-products, and various technical problems relating to the handling of milk, need careful study.

Along all these lines there is need for the bureau to extend its work.

Splendid progress is being made, but the field is so large and the problems so intricate as to require enlarged personnel and facilities. The dairy industry has grown so rapidly in extent that improvement has not kept pace, and in many ways prevailing practices are not satisfactory. The development of good herds is so uncertain and so little is known of the fundamentals of breeding dairy cattle and of milk secretion that the improvement in our herds is tedious and costly. On the other hand the products of the dairy play so large a part in the diet of the American people and are so essential to national welfare that the Government is fully justified in extending its efforts to assure an adequate supply of safe milk and milk products at moderate cost and to have these products fully utilized.

DAIRY RESEARCH LABORATORIES

The work of the research laboratories, L. A. Rogers in charge, includes investigations on the milk secretion and nutrition of dairy cows, the bacteriology and chemistry of milk, fundamental problems concerned with the manufacture of butter, cheese of various types, ice cream, condensed and evaporated milk and milk powder, and the utilization of dairy by-products.

This work covers not only laboratory investigations, but through the facilities afforded by the farm at Beltsville, Md., and the factory at Grove City, Pa., the development of feeding practices and factory methods.

MILK SECRETION AND THE NUTRITION OF DAIRY COWS

A study is being made of the non-volatile organic acids of alfalfa hay in order to ascertain, if possible, why the calcium of this hay is so much better assimilated by dairy cows than that of such materials as bone meal and ground limestone.

A report of the work of 1923 and 1924 on the assimilation of calcium by cows from different kinds of hay over long periods and on certain general physiological aspects of calcium and phosphorus metabolism has been prepared for publication.

The work on the effects, on milk yields and reproductive capacity of dairy cows, of feeding rations containing different quantities of calcium

over long periods and under practical conditions is being continued.

A paper on protein metabolism as related to milk secretion, submitted in 1924, has been published. The results reported show that it is very desirable to be able to determine not only the total amino nitrogen but also the quantities of various single amino acids circulating in the blood of milking cows. Work on the determination of tryptophane in blood has therefore been continued, and a method has been devised which is thought to be satisfactory. Work on the determination of cystine in blood was begun in the fall of 1924 and is being continued.

Throughout the year an experiment has been in progress to determine what system of measuring the energy values of different feeds indicates most accurately their relative values for maintaining nutritive equilibrium in dry cows. The experiment is well along toward completion and the results to date indicate that the metabolizable energy of feeds is an accurate index of their relative values for maintaining nutritive equilibrium, while the figures for net energy value assign too high values to some feeds and too low values to others. Two papers on this subject have been submitted for publication.

BACTERIOLOGY OF MILK

In a study of the proteolytic bacteria of milk, about 216 pure cultures of proteolytic bacteria were isolated from milk from various sources. A study is being made of some of the morphological, physiological, and biochemical characteristics of these organisms in an attempt to understand their action on milk and to classify them into well-defined groups. Their ability to ferment certain sugars has been investigated and a study is being made of their action on gelatin, casein, and simpler nitrogenous compounds.

The investigations on the high-acid group show that none of the available cultures of *Lactobacillus bulgaricus* grow at a surface tension of 40 dynes or lower, while all the laboratory cultures of *Lactobacillus acidophilus* grow well in a broth with the surface tension as low as 36 dynes. In consideration of the well-known surface-depressing action of bile, this offers a reasonable explanation of the ready acclimatization of acidophilus in the intestines while bulgaricus does not become established.

In the fermentation of a sugar broth by a streptococcus the number of cells per cubic centimeter reaches a maximum which is apparently higher if the hydrogen-ion concentration is held constant. At this maximum, multiplication ceases, but fermentation continues, though at a slower rate than during the multiplication period. Later, fermentation stops abruptly. Sugar consumption and acid production parallel each other closely, but only a part of the sugar consumed can be accounted for by the acid formed. Lactic acid constitutes about 96 per cent of the acid formed.

Work has been started on a comprehensive comparison of methods of grading milk. Some preliminary results have been obtained on the determination of bacteria in composite samples of milk by the direct count.

EVAPORATED, CONDENSED, AND DRIED MILK

Various factors influencing the stability of evaporated milk under sterilization have been studied, including the effect of bacterial action, hydrogen-ion concentration, reaction to the alcohol test, and the addition of different anions, particularly citrates, borates, phosphates, and lactates. Normal fresh alcohol-negative milk was investigated, as well as milk secreted alcohol-positive from normal cows. Stability curves show a definite optimum concentration of the anions studied, as well as the pronounced effect of the hydrogen-ion concentration upon stability aside from salt balance. A modification of the alcohol test seems to show a decided correlation with stability in the sterilizer. The curves obtained also offer an explanation of some of the discordant and apparently contradictory results of previous investigators.

Further experiments with the milk of individual cows confirm earlier observations to the effect that there is not necessarily a direct relation between the balance of ash constituents and the heat coagulation.

In connection with the theory that different protein substances may cause coagulation of milk under different circumstances, it has been shown that not all the protein present must coagulate when a curd is formed. Some measurements have been made on the total amount coagulated. As an example, rennet whey from which some of the protein has been separated by the rennet, if heated to 95° C., will give a curd. If this curd is separated a still further curd can be formed at higher temperatures if the whey is

concentrated. After these three coagulations there still remains a considerable quantity of protein in the supernatant liquor which can be coagulated with acid.

In the studies on modified evaporated milk and milk powder it has been found possible to prepare a milk which, when diluted for infant feeding, will have a hydrogen-ion concentration approximating that of gastric juice. This is done by acidifying, with a *bulgaricus* culture, to the predetermined pH and concentrating to a point at which the acidity will preserve the milk. Part of the acidity may be obtained by adding lemon juice, thus increasing the antiscorbutic properties. Milk prepared in this way, modified evaporated milk, and modified milk powder are being prepared for shipment to the Army Medical Research Board of the Philippines.

Factors affecting the keeping quality of milk powder have been studied and a quantitative method has been devised for measuring the susceptibility of fats to oxidation. An apparatus has been devised by which the induction period can be measured automatically.

Concentrated sour milk has been made on a commercial scale at Grove City whenever surplus skim milk was available. Selling at the factory at 4 cents per pound, including container, it nets 62 cents per hundredweight of skim milk. The quantity sold this year is about twice that sold in an equal period last year. The process of preparing poultry feed from this concentrated sour milk has been established in a number of factories, and already a very large quantity of skim milk that formerly was wasted has been converted into a marketable product. Cooperative experiments with the Bureau of Chemistry show that this product improved the elasticity and texture of bread, increased the weight of the loaf, and cut down the fermentation period by 15 minutes, but diminished the size of the loaf.

CHEESE INVESTIGATIONS

Studies during the past year on the bacteria concerned in the ripening of Swiss cheese have shown that niszler and other types of gassy cheese are not due to any one organism but are caused by the physiological condition of the cells at the time the cheese is made. The same organism has been made to produce all types from violent pressler to true niszler. Incubation of the milk tends to suppress certain types of gas.

A study of the growth of the starter as affected by the temperature in the process of manufacture indicates that the prompt growth of the starter organism after the cheese is dipped is dependent on the age of the starter and the temperature at which it is grown. This shows that a young starter is desirable because it has a shorter lag, a high bacterial population, and low acidity, thus permitting the use of a larger quantity without injury. Experimental cheeses with heavy inoculations of gas cultures indicate that abnormal fermentations can be controlled by regulating the stage of development of the bulgaricus culture.

Work on the control of abnormal gas in Swiss cheese by the use of oxygen gas has been only partially successful. In experiments at Grove City niszler fermentation was encountered only once. In this case the untreated cheese was graded as No. 2, while the duplicate treated with oxygen was fancy. In the early stages of ripening the treated cheese showed better eye formation, but when the ripening was completed there was little difference.

Filtering through cotton has much the same effect on eye formation as centrifuging, but to a less degree. There is a slightly greater fat loss in cheese from centrifuged milk and the curd is distinctly softer. There are some indications that the marked effect of clarification in causing fewer and larger eyes may be due to a loss of some of the milk salts. It has been shown not to be due to the aerating effect of the centrifuging.

In continuing the work on glass cheese it has been found that a better texture is obtained if the bulgaricus starter is reduced to one-fourth of 1 per cent.

A comparison made between experimental Parmesan cheeses and imported cheeses of known age show that the cheeses made in the laboratory are drier, either because of lack of water incorporated originally or because of too much drying in the curing room.

The imported cheeses show little flavor at one year and indicate that at least two years' curing will be necessary in the experimental cheeses.

It has been found that cheese of the Neufchatel type often becomes unsalable, owing to the development of a sharp acid flavor followed by bitterness. This defective flavor is always accompanied by a marked increase in the anaerobic spore-forming bacilli coincident with an increase in the volatile acids in the cheese. The bitter

flavor can be produced experimentally by inoculating the milk with a pure culture of an anaerobic spore-forming bacillus which has been isolated from samples of bitter cheese. This organism survives ordinary pasteurization.

Nearly 2,000 Roquefort cheeses have been made during the last year at Grove City, Pa. The cheeses show a greater regularity of texture, flavor, and mold development than formerly.

UTILIZATION OF BY-PRODUCTS

The amount of sugar removed from whey by concentration has been increased to about 90 per cent of the total by crystallizing near the freezing point. By adding sodium sulphate to the mother liquor and taking up the resulting precipitate with carbon tetrachloride or alcohol a soluble albumin is obtained which is free from lactose and contains only 2.8 per cent ash.

The electric dialysis cell has been further perfected until it has been possible to remove about 39 per cent of the salt from the mother liquor of whey at a cost for electric current of about one-half cent per liter. Some trouble is still experienced by the separation of albumin on the diaphragms.

The powder obtained from sweet whey by concentrating 9:1, crystallizing the sugar at low temperature, and centrifuging and drying the mother liquor, contains 18 per cent ash, 35 per cent protein, and 45 per cent lactose, and is perfectly soluble. Cooperative experiments with the Bureau of Chemistry show that it can replace egg albumen in various types of confections. Experiments on its use in bread have indicated that it would not be satisfactory.

A bibliography on lactose has been completed and is being kept up to date. It consists at present of about 800 cards with brief abstracts of the articles covered. A review on lactose, with a 250-title bibliography, has been published in Chemical Reviews, Volume II, No. 1.

An attempt to utilize lactose by converting into benzoyl derivatives has been unsuccessful.

ICE CREAM

In a study of the relation of composition and treatment of mix to yield of ice cream it was found that the temperature of the mix during the whipping has an effect on the yield. Different mixes have different optimum temperatures for whipping. If the freezer is too cold when mix is run into freezer, ice crystals are

formed which tend to lower the rate and amount of whipping. It has been found that aging the mix tends to decrease the permanency of the whip. A high initial temperature of the mix with low fat tends to make a high yield, while with a high fat the whipping is retarded. With a low initial temperature results are reversed.

The velocity of the crystallization of lactose has been redetermined and Hudson's figures have been checked. Cane sugar has been shown to exert very little effect on either solubility or crystallization velocity of lactose. By the use of ammonia to accelerate the equilibrium of milk sugar, it has been shown that under usual conditions the rate of separation of lactose from its solution is governed almost completely by the rate of this reaction. Hardening-room tests have shown that temperature of storage is not the important factor in the development of "sand," as has been the accepted opinion. This must not be confused with the "shocking" phenomenon, which really is important.

Attempts have been made to use pure cultures of bacteria to produce desirable flavors in ice cream. *Streptococcus lactis* was found to give a more sweetish flavor, which was liked by some consumers. Other consumers disliked the accompanying slight acid taste and detected it in even slight quantities. Cultures of proteolytic milk bacteria produced a richer flavor, preferred by a majority of the consumers. The texture of the ice cream was very good soon after manufacture, but became thinner after storage in the hardening room for some time. A search is being made for an organism that will increase the viscosity of mix and ice cream.

DAIRY-CATTLE BREEDING INVESTIGATIONS

This work is in charge of R. R. Graves. Four breeding projects are being conducted with dairy cattle. Three of these projects have for their object the determination of the method of mating that will produce dairy cattle that will be pure in their inheritance for uniformly high-producing capacity. The fourth is a test for the effect of heterosis. These projects are:

(1) The continuous use for generation after generation of sires that have proved, by the uniformly high-producing capacity of their daughters, that they possess the inheritance that will give only high-producing capacity.

(2) The comparison, generation by generation, of inbreeding and outbreeding on animals all coming from the same foundation animals. This project has been under way since 1920.

(3) The comparison, generation by generation, of line breeding and outbreeding, in which both the line-bred and the out-bred animals come from the same foundation animals. This project was started in 1919.

(4) The fourth project is the combining of the blood lines of eight distinct Jersey families to test the effect of heterosis and also to throw some light on the breeders' conception of "nicking." All four projects are being carried out in the Beltsville herd.

The first project is mainly in effect at the substation herds, or will be, as rapidly as proved sires can be procured.

In addition to the work in Bureau of Dairying herds, the following institutions are cooperating in carrying out one or more of these projects:

State College of Agriculture, New Brunswick, N. J.

Clemson Agricultural College, Clemson College, S. C.

West Virginia University, Morgantown, W. Va.

University of California, Davis, Calif.

State College of Washington, Pullman, Wash.

University of Idaho, Moscow, Idaho.

Agricultural College of Utah, Logan, Utah.

Reymann Memorial Farms, Wardensville, W. Va. (cooperating with West Virginia University).

University of Maryland, College Park, Md.

University of Nebraska, Lincoln, Nebr.

The producing capacity of each cow in the breeding project in our herds is determined by two official tests, one when the animal is a 2-year-old, and one when it is mature, preferably a 5 or 6 year old. These tests are supervised by the State agricultural colleges in the respective States. When on official test the cows are kept in box stalls, are milked three times a day, are on dry feed throughout the year, and a careful record of feed consumption is maintained. The records made on these official tests are used as a basis for analyzing the results of the breeding projects.

All bull calves born in our experimental herds are lent to farmers' herds in the vicinity under an agreement whereby their transmitting ability for milk and butterfat will be obtained. Those that prove to be exceptionally prepotent in this respect will be used in our experimental

projects or will be lent to institutions cooperating in the breeding work.

The progress made in these projects in our Beltsville herd during the fiscal year follows:

THE INBREEDING-OUTBREEDING PROJECT

The foundation cows in this experiment were divided into Groups A, B, and C, and the cows in each group were mated to a sire that was unrelated to the other two sires. These three unrelated sires were proved—being 6 years old or older when the project started. One of the three was injured and had to be slaughtered, and another one became sterile. Both of these sires were replaced by proved sires of as nearly the same breeding as possible. The three sires now in use in this project, the groups they are mated to, and the number of their daughters, are:

(1) The Moose O'Fernwood, mated to cows in Group C. There are now 12 F_1 (first generation) daughters from this mating, 4 heifers having been dropped during this fiscal year. Four F_1 heifers have been bred back to their sire. Several F_1 daughters will be bred back to their sire during the coming year. Only 6 of the original Group C foundation cows remain in the herd.

(2) Hood's Sophie's Tormentor was the original sire in this group, and he was succeeded by Sophie's Torono 23d. These sires were mated to Group A. There are 5 F_1 daughters by Hood's Sophie's Tormentor and 5 by Sophie's Torono 23d. There are also 4 heifer calves out of daughters of Hood's Sophie's Tormentor by Sophie's Torono 23d. Only 5 of the original foundation cows in Group A remain in the herd.

(3) Tiddledywick's Raleigh was secured at the end of last fiscal year to succeed Karnak's Noble 4th in Group B. To date, there are 6 F_1 daughters by Karnak's Noble 4th and 3 by Tiddledywick's Raleigh. There are 13 foundation cows in this group.

THE LINEBREEDING-OUTBREEDING PROJECT

The foundation cows in this project were all mated to the proved sire Denton Colantha Sir Rag Apple. There was a net increase during the fiscal year of 4 heifers from this mating, bringing the total number of F_1 daughters to 29. There are 13 active breeding foundation cows still in the

herd, 6 of them now in calf to Denton Colantha Sir Rag Apple, so that we are assured that there will be more than 30 daughters of the first foundation sire and foundation cows. To date, 7 of these daughters have completed records with an average production of 15,567.6 pounds milk and 553 pounds fat at an average age of 2 years 8 months.

According to the plan of the experiment, these F_1 cows were to be mated to a sire unrelated to the first sire. The sire secured was Ponderosa Pieterje Ormsby. There are now four daughters of this F_1 generation in the herd and seven more F_1 cows are in calf to Ponderosa Pieterje Ormsby. Unfortunately this bull died in April and another proved sire had to be obtained. We are fortunate in having found a sire, the records of whose daughters indicate that he is highly prepotent in transmitting high milk and butterfat producing capacity. This bull is Varsity Derby Matador, 234809. Six of his daughters have completed records in the North Platte Experiment Station, at North Platte, Nebr., that average 645 pounds fat at 2 years 11 months of age. Several more daughters are making splendid records.

THE FAMILY CROSSING PROJECT

The original plan of this project called for four groups of three females each. Each group represented a distinct family. These groups of females were mated to four different sires, each representing a distinct family. This first mating would then result in four combinations representing two families each. These four groups of two families each were to be interbred, which would give two groups of four families each. When these two groups were mated the resulting progeny would represent the eight families with an equal inheritance from each family. The female groups were small, and sterility and abnormal sex ratios have prevented the groups from coming along evenly. However, there are now six females and nine males, each of which represents two families, and during this fiscal year two females were dropped, each of which represents four distinct families. In addition to these, through the temporary use of a young bull from the inbreeding-outbreeding experiment, we have four other heifers in the herd that represent four families.

BREEDING CONDITION OF THE HERD

There are 84 females of breeding age in the purebred herds at Beltsville, and 12 of these are classed as doubtful breeders. Thirty bull and 30 heifer calves were born. Of the 30 heifer calves, 1 was dead at birth and 4 others died, leaving a net gain of 25 females. One bull calf died and 2 were stillborn.

Complete data are being gathered on the breeding condition of the herd. Cows that do not conceive after 10 or 12 services are now turned over to the nutrition herd for trials on special feed combinations. This plan was started in April.

With the appointment of a veterinary physiologist, a series of experiments bearing on fertility, especially in bulls, are planned, to be carried out at Beltsville.

LENDING OF BULLS

The number of bulls lent to dairy farmers from the Beltsville herd is now 49. Six bulls died or were withdrawn from service, and 21 additional bulls were placed during the year. This is in accordance with the plan of proving the transmitting ability for milk and butterfat producing capacity, as previously explained.

PHOTOGRAPHY

Animal photography is being systematically conducted in each of the experimental herds. Eventually it will be possible to show pictorially the life development of each individual in the herd, as well as that of its sisters, dam, and grandam. Not only do these pictures show striking variations and changes in conformation with the development of the animals, but they record hereditary characteristics which may eventually be studied through several generations of animals. The photographic study is regarded as one of the most important features of our work. These pictures were the source of material for a bulletin on animal photography which has been submitted for publication.

OFFICIAL TESTING

Official testing, as previously explained, is carried on in conjunction with the breeding projects in order to establish in a definite manner the producing ability of the animals.

During the past year 10 Holstein records were completed. The average production was 14,876 pounds of milk and 532 pounds of fat. Eight of the

ten records were made by heifers with first calf. Fourteen Jerseys completed records averaging 10,276 pounds of milk and 562 pounds of fat. Eight of the fourteen were heifers with their first calves.

Fifty-seven records made by Holstein-Friesian cows in the breeding projects, up to and including those made this fiscal year, average 17,050 pounds milk, 3.43 per cent fat, and 584 pounds butterfat, at an average age of 4 years. A total of 50 records have been completed by Jerseys in the breeding projects at Beltsville, and these average 9,569 pounds milk, 5.55 per cent fat, and 531 pounds butterfat, at an average age of 3 years 8 months. It should be explained that these records represent all the cows in the breeding projects as they reach the proper age for testing according to the system adopted; they do not represent the best cows only.

Records of feed consumption for these cows on official test have been kept and are now being tabulated. Curves are being plotted, showing the nutrients required for maintenance and for the quantity of milk produced, and also showing the nutrients actually consumed. So far as charted, these curves show that according to our present knowledge of feeding standards these cows were able to consume more than enough nutrients for their requirements. The factor limiting their producing capacity was not inability to consume sufficient nutrients.

THE PROVED SIRE

As a result of production studies made with the records of animals in the Advanced Register and Register of Merit, the theory has been advanced that a sire's hereditary make-up for producing capacity is indicated by the production records of a number of his daughters, more accurately than the hereditary make-up of the cow for producing capacity is indicated by her individual production record; that where all the daughters of a sire are uniformly excellent producers, this may be taken to indicate that such a sire has in his germinal make-up only those factors that determine high producing capacity, and therefore he is pure or homozygous for the factors controlling high producing capacity; and finally, that by the use of such sires for generation after generation, dairy cattle might be bred that in time would be pure in their heredity for a high producing capacity, and would therefore be uni-

formly high producers and would breed true for this character.

The difficulty is to find these pure sires. In official testing of purebred cattle only the best daughters of a sire may be tested. If a sire has poor-producing daughters they may not be tested, because of the requirements for entry into the Advanced Registry or Register of Merit, and also for commercial reasons.

In cow-testing association herds, however, it is the practice to enter the entire herd on test. In many of these association herds, well-bred registered bulls are in service. The sire's transmitting ability will be accurately measured by the cow-testing association method, because all daughters and their dams, good or poor, will be tested. A movement has been started to obtain the necessary data from the cow-testing associations and to tabulate and analyze these data with regard to the sires in use. It is thought that this movement may have a vital and far-reaching effect on dairy-cattle improvement in this country.

A STUDY OF THE RELATION OF THE CONFORMATION AND ANATOMY OF THE DAIRY COW TO HER MILK AND BUTTERFAT PRODUCING CAPACITY

Anatomical data obtained on packing-house animals.—Arrangements were made with a Chicago packing company to conduct a study of the anatomy of a large number of animals in its plant. As has previously been reported, the animals were selected in the stockyards to represent fairly definite types of conformation. The majority of them were dairy cows, although a few representatives of the beef breeds were included. A number of general observations and 18 external body measurements were recorded for each animal before slaughter. After slaughter all the organs of the body were weighed and part of them were measured. Thirty-one postmortem items were recorded in addition to several internal thoracic measurements. Nearly 400 animals were included in the study. Complete post-mortem data were obtained on more than 200 of them, and partial data on the balance.

In analyzing these data during the past year 43 correlation coefficients have been completed. Twenty-seven of these are comparisons of different factors with the heart weight. The outstanding point brought out to date is the relatively significant relation between the heart weight and the depth of both fore and rear chest, while the relation between heart weight and the width of fore and rear

chest is consistently and markedly less significant. Furthermore, depth of chest is shown to be much more definitely related to other body measurements than is width of chest. The work completed represents only a beginning of the analysis of these data.

Ante-mortem and post-mortem studies of dairy cows of known producing capacity.—For more than two years all cows discarded from the dairy herd at Beltsville have been slaughtered after having been carefully measured according to a program explained below. At the time of slaughter all the organs of the animal are carefully weighed or measured according to the plan followed in obtaining the anatomical data on packing-house animals.

Previous to this year five institutions—Pennsylvania State College, Cornell University, University of California, Kansas State Agricultural College, and North Dakota Agricultural College—have agreed to follow, under our direction, exactly the same plan in their herds and to submit the data to be combined and analyzed with those obtained at Beltsville. During the year a total of 19 complete reports were received from the first three of these institutions. The others are ready to go forward with the work. During the year the Washington State College, the New York Experiment Station at Geneva, and the Iowa State College have been added to the list of cooperators, making a total of eight institutions contributing toward these anatomical studies. Standards and calipers have been designed and made, and a set is being loaned to each cooperating institution. Some famous cows have been measured at the National Dairy Exposition and elsewhere. Permission to obtain post-mortem data on some of these has been volunteered, and one cow in this class, Sophie 19th of Hood Farm, has already been handled according to this plan. Her skeleton has been mounted and is now on exhibit and available for study in the Bureau of Dairying. Everything possible is being done to insure uniformity in methods and comparable results. When sufficient data are available, correlation coefficients will be determined between external conformation and internal anatomy and between internal anatomy and producing capacity.

Photographic record of development.—The exact stages and peculiarities in the development of each calf are recorded by photographs taken according to a definite plan which insures comparable results. Beginning at the age of

10 to 14 days, photographs of every calf are obtained at definite and frequent intervals. During the year 463 photographs were obtained on calves under 1 year of age. One hundred different animals were included. Surprising variations and sudden changes are shown with many individuals at different ages. Frequently a calf that is unusually level at the rump develops a badly sloping rump at some subsequent stage of development. The reverse is equally common.

Body measurements and contours.—For the purpose of recording periodically the exact proportions and dimensions at definite stages of development, a set of carefully selected external body measurements is taken on each female at 3, 6, 12, and 18 months of age. The same measurements are repeated during the third month of the first lactation, and if possible during the third month of some lactation period after maturity has been reached. The same set of measurements is applied to cows to be slaughtered for post-mortem anatomical studies. One hundred and nineteen sets of measurements on 65 different heifers under 18 months of age, 74 sets on producing cows in the third month of lactation, and 8 sets on cows to be slaughtered were recorded during the year. These are being analyzed. Body-surface areas and many other valuable determinations will be made.

In connection with each set of measurements as recorded in definite linear units, the contour or cross-section outline of the fore chest and the paunch are drawn, full size, on a specially prepared cross-lined sheet. These contours are made with an instrument of our design and with a flexible curve ruler. They will permit many determinations, such as angle of ribs, area of any part or all of either cross section, etc. Two contours have been made for each set of measurements as indicated above. Arrangements have been made for measuring the contour areas with a planimeter.

Udder studies.—The developing gland subsequent to the age of 10 to 14 days, while one of the more recent points to be considered, has proved a particularly instructive object for study. Observations are taken at frequent and regular periods until 18 months of age. Not only is the external part of the udder considered, but primary attention is devoted to recording the development of the internal gland tissue from the time the first traces can be detected by palpation. The sequence of development is fairly defi-

nite, but types are almost as distinct and variations relatively as great in heifers from 3 to 12 months of age as in mature cows. During the year 300 observations have been recorded on 56 heifers.

Observations are resumed two months before the cow is due to freshen and taken weekly during the month preceding and the month following parturition. Monthly observations are continued during the entire lactation period. Many items of condition and changes in the udder and its tissue, as well as other body conditions, such as thickness of hide and color of skin secretions, are recorded. During the year 855 sets of observations on 103 different producing cows have been recorded. These, in addition to more than 1,900 previously obtained, are ready for analysis from many angles.

A photographic record is made of the type and condition of udders. Four views are taken—one from the rear, one from the rear with the folds pulled out to show their flexibility, one from the side, and one from the front and somewhat below, taken from between the cow's front legs. This last view has proved to be particularly interesting and significant. The original plan was to select a few cows and take the four views at monthly intervals to record changes taking place during the period of lactation. Later the plan was changed to include all cows in the third calendar month of lactation, for the purpose of comparing different udders under similar conditions. During the year 39 sets of photographs were obtained according to the original plan, and 65 different cows were included on the revised plan.

Removing the udder at the time the cow is slaughtered, filling the secretory system with formaldehyde under pressure, freezing the udder completely, sawing it into sections approximately three-fourths of an inch thick, and cleaning and photographing these sections for gross anatomy studies, is a plan which has been followed in a number of cases. One additional udder has been so treated during the current year. Results have shown extreme variations in glandular structure.

Arrangements have been made for an histological analysis of the minute glandular structure of definite, selected areas of the gross sections. This work has already commenced. In addition, a consideration of the carrying capacity or absorption index of

udder tissue taken from definitely located and similar areas within the gross sections is contemplated.

Comparative anatomy studies.—The conformation of different species of animals is being compared with that of the dairy cow. Special reference is made to the shape of pelvis, slope or angle of rump, etc. The percentage weight of offspring is also being considered. Photographs have been taken of some of the living forms at the Zoological Park. These, together with photographs and measurements of nearly two dozen skeletons in the National Museum, offer splendid material for comparisons. Causes for variations and changes in angle of rump are being sought.

MARKET MILK INVESTIGATIONS

Market Milk Investigations, of which Ernest Kelly is in charge, include three main lines of work, namely: Dairy sanitation investigations, milk-plant operation, and market milk.

The dairy sanitation investigations have to do particularly with research work covering the causes and means of prevention of milk contamination and high bacterial content. They also include the study of systems of control used by States and municipalities to procure a clean, safe milk supply under practical conditions for the farmer.

Milk-plant operation studies include the construction, equipment, and operation of city milk plants which buy milk from producers and pasteurize, bottle, and otherwise prepare it for the market. This work also includes studies in labor and machinery efficiency for plants of various sizes and types.

Market milk includes certain factors other than those covered under the other two lines of work, such as the effect of various processes on the physical and chemical qualities of milk and cream. It also includes the effect of feeding and other practices on the quality of market milk and cream aside from chemical and bacteriological factors.

MILK PLANT MANAGEMENT

These studies have been carried on during the past year very vigorously and valuable information has been obtained, a great deal of which has been disseminated among milk dealers through monthly milk-plant letters. These letters have met with very fa-

vorable comment and response from milk dealers all over the country.

Labor studies have been conducted at 125 milk plants, and have brought in complete data and sketches of the various plants. The data, which are now being compiled, will show the effect of various plant arrangements and systems on the number of men required for different operations. Following are some of the results indicated so far:

(1) There are wide variations in the efficiency of milk-plant operations at plants of similar size and in the same section of the country, as well as for plants of various sizes and in different sections of the country. The causes of inefficiency at some of the plants have been pointed out.

(2) The studies made of checking out routes have indicated the most desirable systems of plant arrangement required where a large number of wagons must be checked out in a short time, and also the most efficient systems from the standpoint of labor requirements.

(3) Considerable saving in labor can be effected by using a direct system of washing and filling bottles without any intervening storage of bottles. This, of course, requires a cooling system on the bottle washer or a special type of bottle washer.

(4) Properly arranged conveyor systems for handling bottles returned from the routes and at the washers and fillers are a means of considerable saving in labor.

(5) Well-arranged conveyor systems and proper location of weigh cans and can washers have resulted in economies in the man power required for receiving milk at many of the plants.

Studies were made at 20 milk-receiving stations. These surveys included the layout and arrangement of plants, equipment used, and cost of buildings and equipment; also cost of operation at some of them.

Studies were conducted in cooperation with the Minnesota State Board of Health on the effect of various factors and factory methods on the creaming ability of market milk. The work has been completed and the report has been published as Department Bulletin 1344, Effect of Various Factors on the Creaming Ability of Market Milk.

DAIRY SANITATION INVESTIGATIONS

Tests were conducted at the United States Naval Academy dairy on length of life of milking-machine rubbers

under different methods of sterilizing. Three units were used. One was sterilized in a solution of brine and chlorine of lime containing 1 to 5,000 parts of available chlorine. The other two were sterilized in hot water, the temperature of which ranged from 160° to 166° F. The average temperature was about 163° F. One of the units remained in the hot water between milkings, the water cooling gradually. The other was removed after a period of 40 to 45 minutes and placed in the cold-storage room. The average length of time the units remained in the hot water was about 30 minutes. The length of life of teat-cup liners to date is:

Hot water (between milkings) (completed), 175 milkings on 105 days.

Hot water (between milkings) (still in use), 107 milkings on 66 days.

Hot water (cold storage) (still in use), 290 milkings on 176 days.

Salt and chlorine (still in use), 290 milkings on 176 days.

When used but once a day teat-cup liners sterilized in hot water and allowed to remain there between milkings lasted 250 milkings.

The other rubber parts have lasted for 290 milkings on 176 days and are still in use.

Some time has been spent in securing proper equipment for conducting experimental work on sterilizing dairy utensils. A 2-horsepower steam boiler was purchased and three sterilizing cabinets built of concrete, wood, and galvanized iron, respectively. These sterilizers have been connected with the boiler in such manner that comparative efficiency tests may be run with a view to determining which is most economical for farm use.

Fly-control work was started at Beltsville in August, 1924. Ten large fly traps were built and put in operation about the 1st of September. During the first three weeks the number of flies in the milk room and barns was noticeably reduced. A kerosene extract of pyrethrum was used with an air-pressure spray to kill horn and stable flies on the cows. After using for a week on consecutive days there were considerably fewer horn flies to be seen on the cows, indicating that if this work were started earlier in the season these flies could be quite effectively controlled. This summer (1925) the traps were set early, and the number of house flies in the buildings is noticeably less than in former years. This work is being done with the advice and helpful suggestions of the Bureau of Entomology.

During the year 430 samples of milk were studied at one creamery to de-

termine the efficiency of the corrugated cooler as compared with stirring. Milk cooled by means of the corrugated cooler showed improvement in quality over milk cooled by stirring, as indicated by the methylene-blue reduction test.

Further studies were made of better methods of testing the holding time of continuous-flow pasteurizers. Nine chromogenic organisms found in pasteurized milk were isolated. Pasteurizing and thermal death point determinations were made. In no case can these organisms be used in testing continuous-flow pasteurizers if a temperature of 145° F. is used. Experiments with lampblack, charcoal, and India ink showed that these substances were not suitable.

The farm at Beltsville has been inspected once each month from a sanitary standpoint.

The three milk plants having permits to sell pasteurized milk and cream in buildings of the Departments of the Treasury, Commerce, and Agriculture were each inspected once a month. During the year 46 bacterial counts were taken of the milk from each of the plants. The highest count was 92,000 and the lowest 500, with an average count of 14,876 bacteria per cubic centimeter. Out of the 138 counts made, 63 were under 10,000 per cubic centimeter. This is a decrease from the average count of 18,903 in the previous year.

The examination of the United States Naval Academy dairy at Gambrills, Md., is being continued. Ten scores have been made of the dairy, which averaged 97.1, the highest being 98 and the lowest 96.1. One hundred samples milked by hand and taken at the barn showed an average count of 2,625. The highest count was 26,000 and the lowest 100. There were 51 samples taken of the mixed herd milk at the milk house after the milk had gone over the cooler and had been placed in cans. The average count of these samples was 4,611, the highest count being 15,400 and the lowest 650.

MARKET MILK AND CREAM

The laboratory studies of factors affecting the foaming of milk and cream have been continued. The general conclusions are that aging has little effect. For skim, 3 per cent. and 5 per cent milk, foaming is least at 20° to 30° C.; and greatest at 80° C. At low temperatures (5° to 10° C.) skimmed milk gives the greatest foam at the immediate reading, while at the one-minute reading cream gives

the greatest foam. At high temperatures (60° to 80° C.) the milk and cream give approximately the same amounts of foam.

The studies in the laboratory on the effect of various factors on the viscosity of cream have been continued. The work on this project has progressed to a degree where the following conclusions may be drawn:

(1) The viscosity of cream decreases rapidly with an increase in temperature until a temperature of 30° C. has been reached, after which the decrease is very slow.

(2) The viscosity is only slightly decreased by increasing the temperature from 62.5° to 80° C. However, upon cooling, the product heated to 62.5° returns nearer to the original viscosity than that heated to 80°. Holding at these temperatures for one-half hour decreases to a very slight extent the viscosity to which the cream will return upon cooling, as compared with heating and cooling immediately.

(3) Standardization has practically no effect on the viscosity of cream.

(4) Gravity-separated cream has a slightly higher viscosity than centrifugally-separated cream containing the same percentage of butterfat.

(5) Aging greatly increases the viscosity of raw cream. The relative increase is greater in cream containing 30 and 40 per cent of butterfat than in 20 per cent cream.

(6) Pasteurization greatly decreases the viscosity of cream. Although aging will restore the viscosity of pasteurized cream to a slight extent, it is not restored to equality with the viscosity of the original raw cream.

During the year two additional bulletins have been published on the effect of various feeds on the flavor and odor of milk. One bulletin deals with cabbage, potatoes, and garlic, and another with the effect of green rye and green cowpeas. Work to determine the effect of feeding wet beet pulp on the flavor and odor of milk has been completed. The important factors brought out by all these experiments on the effect of feeds upon flavor and odor are as follows:

(1) Feeding succulent feeds before milking is very likely to impart undesirable flavor and odor to the milk.

(2) The longer the time elapsing between feeding and milking, the less pronounced will be the undesirable flavors and odors resulting from the feeds.

(3) Feeding succulent feeds immediately after milking has little or no

detrimental effect on the flavor and odor of milk.

(4) Prompt and proper aeration of the milk will remove slight off flavors and odors and will lessen the intensity of strong flavors and odors.

Work has been started in cooperation with the Animal Husbandry Division of the Bureau of Animal Industry on the flavor and odor of goat's milk. It may be said that the samples so far submitted have been of excellent quality as far as flavor and odor are concerned. Experiments have been started on the effect of certain feeds on the flavor and odor of goat's milk to see whether or not similar conditions prevail as in cow's milk.

Work has just been started on the effect of transportation from the farm to shipping point or point of delivery on the creaming ability of milk. This is to determine the effect of agitation, temperature of milk, and various other factors, and to find means of preventing anything which detracts from the subsequent creaming ability of the milk.

DAIRY INTRODUCTION

This branch of the bureau's work was in charge of S. C. Thompson until his death in April, 1925. From that time to June 30, 1925, J. R. Dawson, dairy husbandman, was acting in charge.

This office is responsible for introducing to the States the results of investigations that have been worked out in the laboratories and at the farms and have proved to be of practical importance. Specialists assigned to this work also carry on investigations in production, manufacturing, and utilization of milk.

Economical production is stressed through work on cow-testing associations, bull associations, purebred-sire campaigns, and improved feeding methods. Better manufacturing practices are brought about through specialists who assist creameries, cheese factories, and other establishments in making a higher-class product. Milk utilization is carried on through city and county milk-for-health campaigns. The work is done in cooperation with the State agricultural colleges.

MILK UTILIZATION

As in previous years, the major part of the work of this project has been in conducting cooperative milk-for-health campaigns.

The purpose of these campaigns is to make a demonstration of organiza-

tion methods in order that the work may spread into other counties in which conditions warrant. In order to accomplish this the State, district, and county agents are assisted by Federal and State specialists. Several States have continued the campaigns in accordance with the demonstration plans.

The ultimate object of this work is to assist in reducing undernourishment and to assist in maintaining health of both children and adults. County-wide surveys were made in five counties. These surveys bear out the findings of former years, namely: Where milk consumption is lowest, undernourishment is highest. A quart of milk a day has been advised as the optimum quantity for growing children and for nursing and expectant mothers. A pint is urged as the minimum quantity.

According to reports obtained through the health departments, the consumption of milk has increased from 10 to 30 per cent in the demonstration centers of the States in which campaigns were conducted. Two States are still conducting the milk campaigns started six years ago. In some cities the campaigns which were started three years ago are still being continued under the direction of the State colleges of agriculture. These cities report an increase in milk consumption ranging from 41 to 60 per cent over what it was before the work had started. These same cities have shown a remarkable decrease in malnutrition, as reported by the health directors of the public schools.

There has been a great demand by various health agencies for our publications. To meet this demand, as well as for our regular use, reprints have been made of several of our circulars. A poster, entitled "In Town and Country, Milk for Health," has been printed. A short film, entitled "Milk for You and Me", was made in cooperation with the Motion Picture Laboratory. This is for use as a trailer in theaters, as well as in rural programs. Slides and other illustrative material have been made for distribution.

COW-TESTING ASSOCIATIONS

The tabulation and study of cow-testing association records have been continued. Comparison of the records of dams and daughters has shown that there is a great difference in sires and that this difference can be measured in quite a tangible way. For example, the daughters of certain purebred

sires excelled their high-producing dams in almost every instance, while the daughters of other purebred sires failed to excel similar dams in a single case. On an average the daughters excelled the dams as long as the records of the dams remained below 384 pounds of butterfat a year. Above that point the dams excelled the daughters on an average. A further study of the records of the daughters of certain sires furnished additional data to show that herd sires should be selected on the records of the daughters rather than on pedigree alone.

In almost every case, where a tabulation of the records of the same association has been continued over a series of years, each succeeding year has shown a higher average production than the preceding year.

For all the associations where the records of 1921 were studied the percentage of purebred herds was 4.6, while for the year 1924 the percentage was 9.9. This is evidence that the association work is gaining in popularity with the owners of purebred herds.

Using the actual daily butterfat production records of 21 cows for one year as a basis, a calculation was made to determine the relative accuracy of weighing and testing one day each month, two consecutive days each month, one day every two months, and two consecutive days every two months. The average error in yearly butterfat production due to weighing and testing only one day each month, as compared with weighing and testing at every milking, was 1.7 per cent; for two consecutive days each month, 1.6 per cent; for one day in two months, 2.6 per cent; and for two consecutive days in two months, 2.3 per cent. These figures indicate that weighing and testing one day each month is almost as accurate as weighing and testing on two consecutive days each month.

Since January 1 the time of one specialist has been devoted to carrying on the work of standardizing cow-testing association methods. The work planned is briefly as follows:

- (1) Unify and correlate cow-testing association operation in the various States as far as possible.

- (2) Improve the quality of records kept, thereby making them of more value to the members of associations, and also of more value to the State workers and to the Bureau of Dairying in carrying on investigations.

- (3) Combine better breeding with the association work and stress the

value of proved sires in improving milk production.

(4) Study through personal contact the operation of other than regularly organized cow-testing associations.

(5) Publish a news letter on cow-testing work to maintain closer contact and furnish a medium for exchange of ideas with the various State field men and others interested.

Cow-testing association forms have been furnished to practically all the States in which cow-testing associations are in operation. Several changes have been made in the forms used at a saving of approximately 35 per cent in cost. The style and efficiency of the forms were not affected.

The annual directory of cow-testing associations in the United States was issued and distributed shortly after January 1. The number of associations increased from 627 to 732 between July 1, 1923, and January 1, 1925.

BULL ASSOCIATIONS

Investigations have been made to determine the factors essential for the successful operation of bull associations. The gathering of data on comparative production of daughters of association bulls and their dams has been continued. It is planned to continue this study, but the field work on bull associations from the Washington office has been temporarily discontinued. Assistance was given in a number of States in organizing several new bull associations.

The directory of cooperative bull associations in the United States was issued shortly after January 1.

SCRUB-BULL ERADICATION CAMPAIGN

A new project started this year is the scrub-bull eradication campaign, which is a definite organized effort to eliminate from a county the scrub, grade, and otherwise inferior dairy bulls, and to replace them with purebreds of good quality. It is conducted by and through the joint efforts of Federal, State, and county extension workers in cooperation with local agencies interested in the development of agricultural interests in the county.

The bureau has cooperated with three States in conducting three county scrub-bull eradication campaigns. Other counties in each State are now taking up the work.

A mimeographed circular entitled "Suggestions for Conducting a Scrub-Bull Eradication Campaign" was prepared and published.

CREAMERY MANAGEMENT INVESTIGATIONS

A study of the methods and costs of operating routes for hauling milk and cream from the farm to the creamery was completed. Data were obtained from eight plants in the Middle West hauling cream, and one in the East hauling both milk and cream, all of them using motor trucks for most of the year. A great variation was found in the methods of operating routes, and the cost of gathering cream at the Middle West plants was found to vary from 1.05 to 2.66 cents per pound of butterfat, the lowest cost being in communities where production was large and a large volume of cream was obtained by the hauler within a small area.

In the manufacture of 116 churnings of sweet-cream butter for storage, cream was pasteurized by the vat method at temperatures of 145° to 165° F. Samples of the butter were stored at 0° F. for seven and one-half to nine months. Scores of the butter after storage indicated that the keeping quality was not influenced by the pasteurizing temperatures used.

CREAMERY INTRODUCTION

Demonstrations of the proper methods of creamery operation have been continued. Efficiency of operation has been increased in a number of plants by adopting methods that reduced losses and increased the overrun. Butter-scoring exhibits were held at several points to demonstrate to the creamerymen the desirability of making high-quality butter and also the financial saving possible by controlling the composition of the butter.

A cream-improvement campaign, which involved personal visits to the farms and the scoring of each patron's cream, was conducted at one creamery. This resulted in a material improvement in the quality of butter manufactured. At another creamery the scoring of each patron's cream and instruction to the dairymen how to produce high-scoring cream raised the average quality of the product delivered at that plant.

NAVY BUTTER

This bureau supervised the manufacture of 435,000 pounds of sweet-cream butter for the Navy Department. Samples of this butter, after seven and one-half to nine months in cold storage, were scored by a competent commercial judge. Of the 166 samples scored the average score was 93.21 points.

RENOVATED BUTTER

Seven renovated-butter factories were in operation during all or a part of the year. At these plants nearly 4,000,000 pounds of renovated butter were manufactured, a slight decrease compared with the previous year. Frequent inspections were made at these plants, special attention being given to sanitation in the plant, quality and condition of the packing stock used, and the quality and moisture content of the finished product.

CHEESE FACTORY INTRODUCTION

Work with the Swiss-cheese factories in Wisconsin and Ohio has been conducted in cooperation with the State universities of those States. Improvements in the quality of Swiss cheese have been made by using a special culture for developing the eyes by using a bulgaricus culture for controlling undesirable fermentation and by running the milk through a clarifier, which results in the formation of fewer and larger eyes.

Swiss cheese was manufactured at one factory in North Carolina. The quality of the cheese was very satisfactory, thus demonstrating the practicability of making this variety in the southern mountains where sufficient milk is available.

Many of the Cheddar-cheese factories in Tennessee and North Carolina increased their output during the year and special attention was given to factories that needed assistance in improving the quality of their product.

WESTERN DAIRY INTRODUCTION

The work of the western office at Salt Lake City, Utah, up to December 31, 1924, continued as in the previous fiscal year. The following projects were conducted in the 11 States: Market milk work, cow-testing associations, bull associations, creamery operation, cheese-factory operation, Delhi community development, and butter standardization.

Surprise milk contests were held in several cities and many samples of milk and cream were scored.

Several bull associations and cow-testing associations were organized.

Educational butter and cheese-scoring contests were conducted.

Blue prints and plans for various buildings were distributed.

The creamery work consisted largely of improving the quality of butter through cream grading, while the cheese work consisted principally of

introducing better methods of manufacturing and giving instructions to cheese makers at short courses.

As it was the intention of the bureau to introduce these projects with the view of discontinuing the work after it was well established, it was deemed advisable to withdraw on December 31, 1924, all of the projects except the market-milk work and cheese work.

A cooperative agent has recently been appointed jointly with the University of Idaho to carry on investigational work with bull associations in that State. As there are 32 bull associations in Idaho, it is a particularly desirable field from which to obtain data on dams and daughters of association bulls. This agent will also act as adviser for the bull keepers and members of the bull associations.

STUDENTS' JUDGING CONTESTS

The annual students' national contest in judging dairy cattle was held in connection with the National Dairy Show at the Wisconsin State Fair Grounds, Milwaukee, Wis., September, 1924. Teams representing 24 colleges and universities in the United States and Canada participated.

The eighth annual students' national contest in judging dairy products also was held in connection with the National Dairy Show at Milwaukee, Wis., September, 1924. Ten teams participated in this contest. Samples of butter, cheese, and milk were scored by the contestants.

The third contest in judging dairy products in connection with the Eastern States Exposition was held at Springfield, Mass., September, 1924.

All of these contests were carried out under the supervision of specialists from this bureau.

DAIRY ENGINEERING

K. E. Parks is dairy engineer for the bureau, and J. T. Bowen is technologist. In the engineering work information has been furnished on the construction of silos and dairy buildings and other problems in dairy engineering in reply to inquiries on those subjects.

A metal building was erected at the Beltsville station. This is to be equipped for experimental work requiring the stabling of animals under a controlled system of temperature and humidity. Weigh rooms have been constructed in three of the milk-holding stables.

The water system has been working to its maximum capacity for a number of years; and in addition to the fact that it is not advisable to depend on a single well and pumping equipment, there is an increasing demand for water as new experimental projects are established. Plans have therefore been made for another well and pumping unit, which should relieve this situation for a considerable number of years.

Pumping equipment has been installed at the Grove City creamery to increase the water supply.

Plans were prepared for a cottage at the Woodward (Okla.) field station, and this building is now being constructed.

The technologist of the bureau has directed electrical, refrigeration, and water-supply work for the Beltsville farm and other work of this bureau, and has prepared plans and specifications of similar work for other bureaus of the department in Washington and at field stations, including an irrigation plant, filtration plant, and water supply at the Range Live Stock Experiment Station at Fort Keogh, Mont., and an electrical plant at the Coastal Plains Experiment Station, McNeill, Miss., both of these for the Bureau of Animal Industry. Assistance has been given to the office of purchase and sales in connection with specifications and awarding of contracts for refrigerating machines, electric motors, pumps, storage batteries, electric plants, transformers, insulation, etc.

DAIRY EXPERIMENT STATION

In addition to the laboratories and main office at Washington the bureau maintains farms and laboratories at Beltsville, Md.; Jeanerette, La.; Ardmore, S. Dak.; Huntley, Mont.; and Woodward, Okla.

THE BELTSVILLE STATION

At the Beltsville station there are now eight permanent buildings used for the experimental work and for living quarters of the persons employed. The original farm comprised 190 acres, but an additional 129 acres were acquired this year. The soil is heavy clay of low virgin fertility. The crops grown are those found to be most profitable, namely, pasture grass, alfalfa, and corn. The crop rotation is alfalfa three years and corn three years. Of the 129 acres recently purchased, 80 acres have been cleared and seeded to pasture grass.

The primary object in establishing this station was to provide facilities for investigations in milk production, particularly those problems which on account of their expense or long duration could not well be conducted by many of the State experiment stations. The general herd and farm management is in charge of T. E. Woodward, superintendent.

The health and breeding condition of the herd, which now numbers about 220 head, has improved. New rooms for weighing and handling the milk at the stables have been built, thus making it possible to produce a more sanitary product. The bull pens have been enlarged and surfaced.

HERD MANAGEMENT

Although milking three times a day for short periods showed only about 12.5 per cent increase over twice a day milking, whole lactation periods gave an increase of about 18 per cent. It was noted that cows milked three times a day held up better near the end of the lactation period than cows milked twice a day. The economy of three times a day milking has not yet been accurately estimated, but will depend upon several factors, chief of which are quantity of production, cost of labor, and value of product.

The work of comparing herd conditions with test conditions on forced production has been completed except the tabulation, which is now in progress. Twenty-three cows have finished one year's work under each of the two conditions. The cows under test conditions gave about 50 per cent more milk and fat, the principal causes of the increase being the extra milking each day and the larger quantity of feed consumed.

FEEDING EXPERIMENTS

Feeding standards have been known for many years, but they have not come into general use by herdsmen, possibly because of the calculation involved in their use. A table has been prepared covering our own particular feeding practice which will materially reduce such work, thus making it easier to apply feeding standards to practice.

Beginning June 5, 1924, 12 milking cows on pasture were fed for 90 days sufficient quantities of grain so that they would have to eat given quantities of pasture in order to receive sufficient nutrients to equal the Savage requirements. The gain or loss in body weight was taken as a physiological indication of the sufficiency of

the ration. The decline in milk production was also noted, but this is of very doubtful value as a real indication of the results, except in confirmation.

The feeding trials for the determination of the requirements for growth of calves from birth to 1 year and of heifers from 1 to 2 years have been completed, but the tabulation of results is not yet available.

One group of calves is being fed a ration containing more protein than is usually fed at this station, while a similar group is fed less protein than is the custom here.

In 1924 the sweet-clover plot furnished 518 cow-days pasture, the grass plot 372 cow-days. So far this year the sweet clover has supported a slightly greater number of cows. Sweet clover is eaten readily by cows as soon as other feed in the pasture is exhausted, and it keeps up the milk flow as well as pasture grass. It did not come on earlier in the spring this year than orchard grass or alfalfa.

OTHER STATIONS

At four field stations which are under the direction of other bureaus of the department, the Bureau of Dairying maintains herds for breeding and feeding experiments, and for demonstration of dairy practices peculiar to their respective regions.

All the cows in these herds are given an official test on full feed. The record thus made is taken as a measure of the producing capacity of these animals for use in the breeding experiments.

The herd at Ardmore, S. Dak., was established in 1917 with 18 cows, and the present herd consists entirely of their descendants. The herd is Federally accredited as free from tuberculosis. In order to stay within the allotted funds, it was necessary to reduce this herd during the year and make a large cut in the labor item. A number of animals have been lent to the Utah Agricultural Experiment Station for cooperative breeding experiments. Nine bulls have been lent for proving. Experiments have been made on feeding and management; also observations on cost of production and of raising heifers, and comparison between native and cultivated pastures. The 20 cows that have been officially tested to date average 13,844.6 pounds milk and 462.14 pounds fat at an average age of 3 years and 9 months.

The average feed cost of raising 12 dairy heifers to 1 year of age was \$28.54; and of raising them to 2 years, \$59.64. The comparison of native and cultivated pastures showed for 1924 the following returns over grain cost from milk produced per acre: Native, \$5.50; sweet clover, \$12.23; wheat grass, \$10.96; brome grass, \$10.29. For 1923 the results were: Native, \$11.27; sweet clover, \$14.30; wheat grass, \$21.09; brome grass, \$16.77. The season of 1924 was very dry, while 1923 had a normal rainfall.

The investigational work of this bureau at the Huntley, Mont., station is conducted along the following lines: (1) Effect of pregnancy and other factors on weight of cattle; (2) breeding experiments; (3) methods of feeding; (4) the proving of bulls; and (5) pasture-carrying tests, including effect of manure on irrigated pastures. Thirty purebred Holstein sires have been lent to dairy farmers on the Huntley project and in the Yellowstone and Big Horn Valleys. A young bull is now being used in the Huntley Experiment Station herd that was tested out in a farmer's herd on the project, and showed remarkable transmitting ability.

The experiment to determine the carrying capacity of an acre of irrigated pasture has been continued for six years. The yearly average, including the figures for 1924, shows the length of the grazing season to be 137 days with a total of 292 cow days per acre per year. This is at the rate of slightly more than two cows per acre. The supplemental feed was alfalfa and averaged 973 pounds per cow for the season. Without deducting for hay fed, the average production per acre was 7,554 pounds of milk and 291.8 pounds of butterfat. Irrigated pastures manured each year for four years gave 20 per cent more cow days per acre than the unmanured pastures in 1924.

Comparisons have been made of three planes of feeding dairy cows: (1) Full grain ration with roughage; (2) limited grain ration with roughage; (3) roughage alone (no grain fed). The roughage in all three rations consisted of alfalfa hay, corn silage, and beets. Six cows have completed records on all three rations, and the returns over cost of feed in excess of pasture averaged \$89.23 for the full grain ration; \$134.98 for the limited grain ration; and \$109.81 for the roughage ration. Twelve cows have completed records on two of the ra-

tions with an average return over cost of feed in excess of pasture of \$83.97 for the full grain ration, and \$107.02 for the ration of roughage alone. The 12 cows fed only roughage produced on the average 12,128 pounds of milk and 436.05 pounds of butterfat.

The station at Woodward, Okla., was established in 1921 for the purposes of determining how well and completely dairy cows can be fed on crops grown on a dry-land farm with a minimum of purchased feed and of serving as a demonstration of dairy methods for that region. Seven bulls have been lent to dairymen in the vicinity of Woodward and are being proved. Six cows from this station have been lent during the year to the Utah Agricultural Experiment Station for cooperative breeding experiments. Costs on raising heifers have been kept and pasture experiments made.

Official records have been completed on 12 cows and heifers with an average production of 15,893.3 pounds milk and 557.21 pounds butterfat, at an average age of 4 years. Omitting the records of four 2-year-old heifers, the average was 17,102.9 pounds milk and 600.47 pounds butterfat. Four of these cows are State champions in their respective age classes.

The dairy herd at Jeanerette, La., now consists of 21 purebred Jersey cows, 18 heifers under 2 years old, and 12 young bulls. Four bulls were lent out during the year, making nine now being proved by Louisiana dairymen. Seventeen cows have been milked during the year, and costs have been recorded on production of milk and butterfat and on raising heifers.

The average cost of raising 13 purebred heifers from birth to 1 year of age was \$78.90, and to 2 years \$128.93. For 12 grade Jerseys it was \$74.15 for the first year and \$121.07 up to 2 years.

The three cows that completed official records during the year averaged 8,429.5 pounds milk and 463.58 pounds fat.

LITERATURE, EXHIBITS, AND MOTION PICTURES

During the year the bureau issued 53 new or revised department publications. These include papers published by the department and articles printed in scientific journals. Among them were 6 Farmers' Bulletins, 5 Department Bulletins, 8 miscellaneous circulars, 30 technical papers and reports of investigations, and 4 lantern-slide lectures. In addition, 36 manuscripts of popular articles were prepared for publication in agricultural and trade journals, besides press notices circulated by the Office of Information.

In cooperation with the Office of Exhibits and various bureaus of the department, this bureau planned and furnished material for a comprehensive dairy exhibit at the National Dairy Exposition held at Milwaukee, Wis., in September, 1924. The theme of this exhibit was better cows, better care of cows, and better dairy products.

Two motion pictures were completed during the year. One is a three-reel film entitled "Weighed in the Balance" that emphasizes especially the value of cow-testing association work, but brings out also other correct dairy practices. The second film is a short trailer, called "Milk for You and Me," designed for use in motion-picture theaters in connection with milk-for-health campaigns.

Four sets of lantern slides were prepared to illustrate lectures on the following topics: Production of clean milk, Making butter on the farm, Milk in the home, and Stories from cow-testing association work.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., September 4, 1925.

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1925.
Respectfully,

WM. A. TAYLOR,
Chief of Bureau.

Hon. W. M. JARDINE,
Secretary of Agriculture.

This report does not aim to give a complete summary of all the activities of the Bureau of Plant Industry during the past year, but rather to record some of the significant accomplishments of the year which have not been reported elsewhere. In general, the investigations under way are of indefinite duration, and frequently problems may be under consideration for extended periods of years before definite conclusions can be reached. A satisfactory outline of the functions of the bureau would necessitate a review of the results described in publications of the department or in other articles published by the specialists of the bureau that report in detail the progress of the various lines of investigation. A list of the publications issued during the year is appended.

The activities of the Bureau of Plant Industry are primarily devoted to agricultural research and related experiments. This work includes the study of destructive plant diseases and the establishment of methods of eradication and control; the improvement of crop, ornamental, or other economic plants by breeding and selection; the introduction of promising seeds and plants from foreign countries; the improvement of methods of

plant production; and the utilization of plants of economic value.

The campaigns to control or eradicate certain plant diseases are conducted in cooperation with the authorities of the States concerned. The 13 States interested in spring-wheat production are cooperating to eradicate the common barberry throughout this area as a means of controlling epidemics of black stem rust of wheat. The New England, Great Lakes, and Northwestern States are cooperating in the eradication of the black currant and related plants as a means of controlling or preventing the spread of blister rust of white pine. The Gulf States are cooperating in the eradication of the canker of citrus trees and fruits.

The regulatory activities are limited to the enforcement of the seed-importation act.

The appropriations available for the work of the bureau for the year were \$3,839,405. This was apportioned, as authorized by law, to the several types of work under way, approximately as follows:

Research work	\$3,021,405
Control and eradication work	800,000
Regulatory work	18,000
Total	3,839,405

The work of the bureau has been carried on under the following heads:

Office of the chief-----	Wm. A. Taylor, chief of bureau. K. F. Kellerman, associate chief of bureau. H. E. Allanson, assistant to the chief of bureau. Erwin F. Smith, senior pathologist in charge.
Laboratory of plant pathology-----	C. L. Shear, senior pathologist in charge.
Plant-disease survey and pathological collections-----	M. B. Waite, senior pathologist in charge.
Fruit-disease investigations-----	Directed by the associate chief of bureau.
Citrus-canker eradication-----	Haven Metcalf, senior pathologist in charge.
Forest pathology-----	S. B. Detwiler, senior pathologist in charge.
Blister-rust control-----	H. A. Edson, senior pathologist in charge.
Cotton, truck, and forage crop disease investigations-----	W. T. Swingle, senior physiologist in charge.
Crop physiology and breeding investigations-----	F. Löhnis, senior bacteriologist in charge.
Soil-bacteriology investigations-----	Oswald Schreiner, senior biochemist in charge.
Soil-fertility investigations-----	O. F. Cook, senior botanist in charge.
Acclimatization and adaptation of crop plants-----	L. H. Dewey, botanist in charge.
Fiber-plant investigations-----	W. W. Stockberger, senior physiologist in charge.
Drug and related plants-----	H. L. Shantz, senior physiologist in charge.
Plant physiological investigations-----	N. A. Cobb, senior nematologist in charge.
Agricultural technology-----	E. Brown, senior botanist in charge.
Seed-testing laboratory-----	C. R. Ball, senior agronomist in charge.
Cereal investigations-----	W. W. Garner, senior physiologist in charge.
Tobacco and plant-nutrition investigations-----	T. H. Kearney, senior physiologist in charge.
Alkali and drought resistant plant investigations-----	E. W. Brandes, senior pathologist in charge.
Sugar-plant investigations-----	Frederick V. Coville, senior botanist in charge.
Economic and systematic botany-----	E. C. Chilcott, senior agriculturist in charge.
Dry-land agriculture investigations-----	C. S. Scofield, senior agriculturist in charge.
Western irrigation agriculture investigations-----	L. C. Corbett, senior horticulturist in charge.
Horticultural investigations-----	J. W. Byrnes, assistant in charge.
Experimental gardens and grounds-----	E. C. Butterfield, horticulturist and superintendent in charge.
Arlington Experiment Farm-----	David Fairchild, senior agricultural explorer in charge.
Foreign seed and plant introduction-----	C. V. Piper, senior agronomist in charge.
Forage-crop investigations-----	R. A. Oakley, senior agronomist in charge.
New and rare seed distribution-----	G. N. Collins, senior botanist in charge.
Biophysical investigations-----	

FRUITS

CITRUS

Root stocks.—The solar propagation frame designed for rooting citrus cuttings which was described in the report of last year is being utilized on a commercial scale with most satisfactory results in the Gulf coast sections in handling cuttings, not only of citrus but also of certain ornamentals which in the past have been hard to propagate vegetatively. Modifications of the solar frame have been found advantageous in sections having cold nights during the rooting period. The installation of a cheap auxiliary heating outfit, either electric or oil burning, will prove profitable and sometimes will be absolutely necessary to success, although the application of artificial heat may not be needed more than an hour or two during the night.

For the production of citrus stocks from cuttings on a commercial scale a field demonstration has been undertaken in the propagation of cuttings of the Rusk citrange to utilize as stocks for the Satsuma orange. It is conceded by conservative horticultur-

ists in the section of Alabama where Satsuma oranges are grown that the citrange used as a stock would afford a distinct advantage over the trifoliolate orange, the stock now almost universally used. This is due to the fact that a freeze severe enough to kill the Satsuma top results also in the death of the root system when budded on trifoliolate stock. The hybrid stock (citrangle) under the same conditions sprouts freely and may be rebudded, thus reestablishing the grove in bearing condition within two or three years.

Cooperative plantings of Satsuma orange varieties and strains on this and other hybrid stocks have been arranged in most of the Gulf States, and a 10-acre grove is being developed on leased land in southern Alabama, where the Satsuma industry is centered. This grove is designed not only to test new hardy stocks but to develop differences in resistance to frost and disease that may be inherent in different Satsuma strains and varieties. Many "false" hybrid Satsuma strains are included in this test. Some of these came through the freeze of 1924 with slight injury as compared with standard Satsuma trees.

The Wase variety of Satsuma orange introduced from Japan has been distributed to a limited number of cooperators for testing in the Gulf States, under an agreement providing for adequate observation as to its adaptability before any commercial propagation is undertaken. This variety, originating as a bud sport of the standard Owari Satsuma, matures from two to four weeks earlier than the parent variety, is of large size, presents a fine appearance, and is free from fiber, or rag. Its chief weakness, as reported in Japan, is a tendency to revert to the original type. Several different strains of the Wase have been imported from Japan, and these are being tested under uniform conditions, with the hope that one may be found having greater stability than the original Aoe Wase, the only strain grown on a commercial scale in Japan.

The 2-year-old sour-orange trees propagated from root cuttings and grown at the experiment nursery of the Fruit Growers' Supply Co., of the California Fruit Growers' Exchange at Altadena, Calif., were dug in January, 1925. The trees planted in the open had made a much greater growth than those kept for two years in the lath house. It was also noticeable that the 2-year-old trees grown from root cuttings had developed a much stronger root system than the 2-year-old seedlings in adjoining rows given the same care under identical cultural conditions. The sour orange, particularly the Spanish strain, in which interest especially centers, has a tendency to produce two to five good, strong-rooted layers from each cutting, thus giving considerable material for future propagation work. Another outstanding feature brought out by this investigation of citrus stocks is that the Spanish strain is much more uniform than any of the material which traces back to seedling sour-orange trees from either Florida or California.

Bud selection.—A very striking illustration of the continued high yielding of trees originally selected as superior is shown by the records of the East Highlands Orange Co. orchards at East Highlands, Calif. These orchards include about 800 acres of Washington Navel oranges and small plantings of Valencia orange and Marsh grapefruit trees. The first complete set of records was obtained during the years 1914, 1915, and 1916, and the second set covers a period of two years, beginning in 1922. In the first series of records only those trees

were selected for propagation which showed an average yield per tree of 10 field boxes of oranges a year. This orchard has been gone over recently, and only those trees which have shown an increased average yield over that of the first period have been used as further sources of budwood. A few trees were also selected for cutting budwood which were high yielding in the first record and which have been very high producers during the second period of record keeping. Of the trees selected on the basis of their performance record during the first period, 95 per cent have been selected for further use as sources of budwood on the basis of the second performance-record results.

The results obtained in previous seasons confirm the importance of careful bud selection in the propagation of citrus trees, in order to avoid the perpetuation of poor-yielding strains producing undesirable fruit. These data have demonstrated that in each of the varieties studied it is possible through systematic bud selection to isolate superior strains which produce more uniformly good crops than orchards in which the trees were propagated without careful bud selection.

Although many of the limb variations show undesirable fruit characteristics, a number of limb sports have been found and propagated which are superior to those of the parent strain. These characteristics include improved size, shape, and color of the fruit, texture and appearance of the rind, and eating quality or other important factors in the merchandising of these fruits.

Pruning.—Orange and grapefruit trees which have been properly grown from selected buds need very little pruning. Although the removal of abnormal growth, crossed limbs, diseased or dead branches, and other objectionable features is unquestionably a desirable practice, the heading back and continued attempts to direct and train the tree tops by pruning have been found to be undesirable in all of the citrus varieties, as the continued pruning stimulates vegetative growth at the expense of fruit production. A study conducted with Washington Navel orange trees to determine the comparative value of pruned and unpruned trees showed that no improvement resulted in grade or size of fruit on the pruned as compared with the unpruned trees. Similar results have been observed in the case of Valencia orange and Marsh

grapefruit trees. These data, together with other similar information, have led to the conclusion that any severe pruning of healthy orange trees is unnecessary under California conditions and likely to be followed by a decrease in the crop.

Frost protection.—The past winter in southern California was particularly favorable for determining the rate of cooling of the oranges on the tree and freezing under natural conditions. Apparatus was designed for freezing the fruit and trees and for accurately measuring the temperatures of the fruit and the air surrounding the trees. In these studies the rate of cooling of some 300 oranges and the temperature of the air surrounding them were determined. These data will serve as a basis for calculating the rate of heat removal from this fruit under various conditions and will make possible a more accurate application of heating to the bearing groves during cold weather. Tests with artificial freezing apparatus to determine methods of preventing damage to young trees were also made. Ordinary newspapers tied around the tree trunks protected them from serious damage under temperatures even lower than those that prevailed last season.

Canker eradication.—As a result of the vigorous campaign conducted by the Gulf States in cooperation with this bureau, citrus canker, a bacterial disease of citrus fruits and trees, has been practically eliminated from the greater portion of this region. No new infections have been reported from Mississippi since November, 1922, and the State is apparently free from canker. No infection has been discovered in Alabama since June, 1924. No new infections have been reported in Texas during the year.

The discovery in March, 1925, of five infected trees on two town lots at Boynton, Fla., was reported. All citrus trees on these properties were destroyed. A rigid inspection of the entire district was conducted, but no more infected trees were found. With this exception Florida has been free from canker since October, 1923.

Scattered infections of nursery stock are still found in Louisiana. During the past year major efforts have been devoted to citrus properties in Terrebonne and Lafourche Parishes, where all trees were uprooted from properties where citrus canker had been found. New trees were planted under permit to prevent own-

ers from planting trees in the same soil or in close proximity to soil from which trees infected with canker were removed. Because of the scattered infections in dooryard plantings in Louisiana and the possibility of similar infections occurring sporadically in other States it will be necessary to maintain at least a reconnaissance inspection of the entire citrus area for several years.

DATES

The commercial culture of dates is rapidly expanding in the irrigated valleys of the Southwest, especially in Arizona and southern California. In the Salt River Valley in particular interest in date culture is rapidly growing, and several experimenters are making very careful trials of choice varieties of imported dates, planted for the most part in the warmest parts of the valley. The date crop in the Coachella Valley in the fall of 1924, although very heavy, was cured and marketed successfully, with gratifying returns to the growers. The Imperial Valley is one of the largest irrigated valleys suitable for date culture not yet given over to that industry to any appreciable extent. It is believed that the Saidy variety is particularly well adapted to those parts of the Imperial Valley where the moist air late in the season prevents the proper ripening of Deglet Noor dates.

In connection with date planting in new regions it becomes of the utmost importance that the palms be as free as possible from insects and fungous pests. In Death Valley, Inyo County, Calif., a commercial plantation is being established in the hope of supplying pest-free offshoots. An attempt is being made to create pest-free date plantations at San Diego, Calif.

AVOCADOS

The Collinson variety.—In the prosecution of avocado studies it has been discovered that one important variety of hybrid origin, the Collinson, is entirely devoid of pollen and thus is absolutely dependent on other varieties for pollination and fruit setting. Furthermore, the Collinson avocado can not function as a reciprocating variety to assist the setting of fruit by other varieties in any mixed planting. This timely discovery doubtless will obviate very considerable losses, as solid plantings of the variety would soon have been made. Since it is very

desirable from other standpoints, the Collinson avocado may be planted with reasonable safety in association with other varieties if the planting is so planned as to provide for the pollination of each variety used.

Frost protection.—Although the destruction of avocado orchards by freezing was less prevalent during the past year than in previous years, the loss was sufficient to indicate that in California artificial heat should be resorted to during exceptionally cold periods in all except the warmest localities and that great caution must be exercised in selecting a locality and site for an orchard. The susceptibility to cold of trees of varying vegetative vigor has been noted on different occasions and appears to be more pronounced with this than with any other of the commonly cultivated fruit crops. Trees which have been sunburned, those with unhealthy roots, and those which have suffered from poor drainage are decidedly more seriously injured by cold than well cared for trees beside them. The effect of a temperature of about 25° F., which occurred in December, 1924, was studied in a collection of 16 varieties lately introduced. The indications are that there is a wide variation in the cold resistance of these varieties. That the resistance of some varieties is only moderate might reasonably be expected when the temperatures in the localities whence the varieties were brought are considered. The wide range of temperatures in California, including very high temperatures in summer, may lower the vitality of the trees and result in cold injury at comparatively high temperatures.

APPLES

Commercial stocks.—The young trees in a collection of 1-year-old commercial apple-seedling stocks were carefully graded to obtain uniformity of size and other characteristics and were then planted under conditions as uniform as possible. At the end of the first season of this experiment there was little difference, but in the fifth season the differences became striking. Some individual trees were 8 feet high, whereas others remained decidedly dwarfed. Although no carefully planned experiments have been conducted to determine the resistance of the trees in this test to such troubles as crown-gall and woolly aphis, nevertheless, they show rather marked differences in the extent to which they are affected by these troubles.

Root-cutting propagation with apple stocks appears to have distinct limitations. Numerous tests of scion roots from commercial varieties have resulted in very low percentages of plants when the roots were cut up and planted as cuttings. The direct propagation of varieties by root cuttings is therefore regarded as commercially impracticable.

Storage condition.—One of the most vital needs of the commercial apple industry is an accurate method of determining the actual storage condition of the fruit at any time between the picking season and ultimate consumption. The mechanical pressure tester which has been used for several years seems to offer the best test yet devised for this purpose. A small hand tester has recently been developed which is portable, and with it tests can be made anywhere. The apparatus has been tested under commercial conditions and has proved to be of considerable value in determining the stage of maturity of the fruit.

During the past two years the rate of softening of a number of varieties of apples under temperatures ranging from 32° to 85° F. has been determined. It has been found that varieties can be grouped according to whether they are slow, medium, or fast in softening at various temperatures. Varieties that are slow in softening at temperatures of about 40° F. are ideal for holding in common storage. Varieties softening rapidly at these temperatures are unsuited for holding in common storage and should be moved into cold storage very promptly if long holding is desired.

Pear-blight.—Rather striking outbreaks of pear-blight on the collars and roots of apple trees of different varieties, such as York Imperial and Ben Davis, have caused considerable loss to bearing orchards in the Potomac Valley. This occurrence of collar blight and root blight on the susceptible seedling roots of budded trees brings discredit on one of the leading methods of propagation, namely, budding above the collar on unknown seedling roots. The remedy, as was pointed out several years ago but only occasionally put into practice, is to propagate the resistant varieties by root grafting, with a long scion and a short piece root or, better, a known root. Varieties susceptible to collar blight may then be top-worked on such trees with resistant collars. A still better method, if it can be developed in commercial practice, will be to propagate resistant sorts by cuttings, mound layering, or some similar

method which will put the resistant varieties on their own roots and then to top-work on such stocks the varieties susceptible to collar blight and root blight.

Pear-blight ordinarily does not attack the mature fruits of summer apples and pears. Occasionally, however, it attacks summer apples right up to maturity, and the same thing probably is true of summer pears. It has not been found on mature winter apples and pears at harvest time in the fall or in storage during winter and under ordinary inoculation conditions will not attack these fruits. Under the forced conditions of the damp chamber or bell jar it has been determined that the pear-blight germ can invade the tissues of mature winter apples and that under similar conditions it develops on the cut surfaces of rose cuttings. The rose has never been found infected with pear-blight under normal conditions.

PEACHES

Freezing storage.—In order to utilize an enormous surplus peach crop that could not be economically marketed in the usual way, work was started in Georgia to develop methods of preserving in cold storage surplus peaches on a large scale for use in the commercial making of ice cream and possibly in pie baking. Peaches of the Carman, Hiley, Belle, and Elberta varieties were stored, uncooked, in various proportions of dry sugar and sugar sirup. These were put up in both peeled halves and finely shredded form in wooden barrels and 10-pound tins. This material proved to be very satisfactory for the making of peach ice cream, as it works up into a smooth product with the true fresh-peach flavor. The material that is not pulped can be used by pie bakers and by those makers of ice cream who desire pieces of fresh peach to be visible in their product. One drawback to this work at present is the comparatively high rates of cold storage in the South. The nearest storage to the peach belt where temperatures below 32° F. can be obtained is at Atlanta.

Canning.—Five of the principal peach varieties grown in Georgia were canned at different stages of maturity, and the results are believed to be of importance in indicating means of improving the quality of the canned product by attention to the stage of ripeness of the fruit used. The lots of peaches canned were tested by means of a puncture tester similar to

that used in studies of sweet corn. The use of the puncture tester has been found to give reliable information as to the rate of softening, both when fruit is left to ripen on the tree and when picked at various stages of maturity. Chemical analyses of the various lots of material show significant changes in the sugars, acids, and tannins as ripening proceeds. The fact must be recognized, however, that the types of peaches grown in Georgia and in the East generally do not result in a canned product of as high a commercial grade as the California pack.

Some comparisons were made between peach pulp preserved by freezing and similar lots preserved by canning. The results indicate that a satisfactory product for use in ice cream can be canned at a cost much lower than that of frozen pulp and that there are other commercial possibilities for the canned material.

Brown-rot.—An application of sulphur dust two or three weeks before picking time in Georgia has reduced the development of brown-rot on peaches in transit in cases where rains were common during the picking season, but in drier weather this dusting has been unnecessary and of little value. A delay of a few hours in cooling peaches makes a decided difference in both the amount and character of the rots that develop later in transit. Brown-rot that has already made a slight start and spores that are lodged in cuts and bruises develop even at 41° F., but spores on the surface of the peach seldom develop rot at this temperature during ordinary shipping periods. At 48° F. and higher temperatures spores dusted on the peaches cause a fairly rapid development of rot without the aid of cuts and bruises in the skin.

In Georgia dusting peaches by the use of airplanes appears very promising provided the airplane companies can afford to do the work cheaply enough. After experimental trials in cooperation with the Bureau of Entomology and with airplane companies certain dusts when applied to peach trees by airplanes give excellent covering and appear to control brown-rot, scab, and curculio.

Phoney disease.—The phoney disease of peaches in Georgia has been increasing in severity. The diseased trees in the old infested areas have increased, and the general area has extended quite widely year by year but, so far as known, has not spread be-

yond the State of Georgia. At the present rate of progress, however, it may be expected to reach other States in a very few years. The results of all experiments to control this trouble have been astonishingly negative. A tree once affected always continues to be diseased. The absence of any effect of soils, fertilizers, or other treatment points away from physiological or nutritional types of disease. This trouble, therefore, stands out distinctly as the least understood of all fruit diseases, if not of all plant diseases.

GRAPES

The phylloxera exists in the main grape-producing sections throughout California. The report of the finding of phylloxera in San Diego County has definitely placed the insects below the southern boundary of the San Joaquin Valley, and in these sections it will be only a question of time until practically every vineyard will be infested. In a study of the spread of the pest within a single vineyard, in connection with the resistant-stock work, it has been found that where vines planted in uninfested soil reach maturity and then become infested approximately five years elapse, varying with soil conditions, before the vines cease to be commercially productive. Further, it has been found that large areas of vines are not killed by the insects but continue in an unproductive state for many years. Specific cases have been noted where the inroads of the insects have decreased the annual acre production from an average of 8 tons to about 1 ton. In one vineyard the acre production decreased from 14 tons in a certain year to 3 tons three years later. This would indicate that a vineyard on its own roots having once become infested with phylloxera rapidly approaches a noncommercial status. If these infested vines are pulled up and the area planted to young vines on their own roots, which is often done, the new planting will not reach a productive state. It is apparent that there is a great commercial need for the adoption of resistant stocks in order to preserve the industry.

Droughts have prevailed in four consecutive seasons prior to the present. Many vineyards have suffered severely as a direct result of this shortage of water and indirectly as a result of inroads made by phylloxera, nematodes, mildew, and other ills, so that many vineyards are in a badly depleted condition. According to the California planting records, the acre-

age in vineyards should now be about twice what it was in 1918. The production in 1924, however, was not as great as it was in 1918, and it is questioned whether there are now as many productive acres of grapes in California as there were five years ago, notwithstanding the heavy plantings that have been made.

BERRIES

Strawberries.—Spraying experiments for the control of strawberry-leaf diseases in North Carolina, in cooperation with the State agricultural experiment station, agree with the earlier experiments in indicating that while these diseases can undoubtedly be controlled by spraying it is usually wiser to reduce them by using the less susceptible varieties and frequently renewing the beds, thus eliminating the cost of spraying.

Shipping experiments showed that the growth of Botrytis on strawberries can not be checked even by the very best refrigeration now available and also confirmed to some extent the observations of British workers that the growth of this rot-producing fungus is checked by small accumulations of carbon dioxide.

The possibility of using strawberries as a crop interplanted with Muscadine grapes trained to an overhead trellis has been successfully demonstrated under the conditions that prevail in the vineyard of the Coastal-Plain Branch Station at Willard, N. C. Strawberries were harvested at the rate of 175 crates per acre. The grapevines between which the strawberries were planted as an intercrop were 4 years old and yielded in the same season about half a ton of grapes per acre. This yield of grapes was considered fairly good for a 4-year-old vineyard.

Shipping quality.—A careful survey was made of the influence of different fertilizer treatments as well as climatic and other conditions in the Pacific Northwest on the actual firmness of strawberries, raspberries, and blackberries (including Logan blackberries) both at the time of picking and following an interval of holding. Little variation could be detected in fruit grown in different ways and under different fertilizer treatments during the past season, which was a very favorable shipping season in the Pacific Coast States. Under less favorable conditions, such as would prevail in a normal season, however, results might be different. At the present time many thousands of dollars are being

spent each year on certain fertilizers solely from the point of view that they improve the texture and shipping qualities of berries.

Freezing storage.—The handling of berries by freezing in barrels, either with or without sugar and usually with no other preservation, has become a very extensive industry in the Pacific Northwest. More than 50,000 barrels of 50 gallons capacity of berries are now frozen each year. Considerable loss results each season from barrels fermenting and blowing up before being cooled through. During the past season studies were begun to determine the rate of cooling of berries stored in barrels, with or without sugar, when held at various temperatures. With berries at 70° F. when stored, approximately four days in a temperature of 15° to 18° are required to cool the berries in the center of the barrel to 32°.

NUTS

GRAFTING

The precautions exercised in the selection and care of scion wood of nut-bearing trees can hardly be too great. This applies with equal force to the care of grafts while they are becoming established and through practically the whole of the first season. With the black walnut, shagbark hickory, and pecan the most satisfactory results have been secured with scion wood between one-fourth and three-eighths of an inch in diameter. The wood should be straight, the bark smooth, the internodes from 4 to 6 inches long, and the buds plump and fully matured.

Experience indicates that the time of cutting back the stock preparatory to grafting by any bark method is not particularly important, provided it is not done during a period immediately preceding or following the opening of the leaf buds. This is particularly true of the Japanese walnut. In other words, it matters little whether the top is cut back and the branches removed in March or whether the cutting is left until the time of operation, although if the work to be done is considerable it is a great saving of time during the grafting period to have the tops removed and out of the way. Only such scion wood as may be used during the day should be removed from cold storage at one time. Wood that has been exposed to the sun and drying winds for a short while becomes materially affected, and

the chances of successful unions are thus lessened.

In bark grafting by the slot method, if paraffin is used it must be kept at the lowest temperature compatible with efficient spreading. The temperatures should be as low as possible without interfering with the thinness of the paraffin; if at all thick it becomes flaky and is inclined to drop off. As evidence of the importance of maintaining a proper temperature of the paraffin it is interesting to record that of 18 grafts coated with paraffin heated by an alcohol flame only 6 (33½ per cent) took, while of 43 grafts coated with paraffin heated by a signal-oil flame, which can be more easily controlled, 22 (51 per cent) took.

A good workable temperature for paraffin is within the range of 175° to 195° F. A temperature of 230° on the basis of laboratory tests is too high. In order to keep an alcohol flame going and to guard adequately against its being blown out by the wind it is necessary to keep the flame so high that it runs the temperature of the paraffin to a danger limit. Where signal oil is used as a fuel the flame can be kept very low without serious danger of its being blown out, and in this way the temperature of the paraffin can be maintained far enough above the melting point to keep it from becoming flaky and yet not so high as to injure the plant tissues when the paraffin is applied to them.

ALMONDS

The almond-breeding investigations are conducted cooperatively with the California Agricultural Experiment Station, and the seeds produced are being grown and cared for at the university farm at Davis. In the breeding work in 1923 about 2,500 nuts were obtained and planted in the nursery in the spring of 1924. About 800 trees have resulted from these seeds. From the crossing which was done in 1924 approximately 15,000 nuts were obtained, and these were planted in the nursery in the spring of 1925. A good percentage of germination was obtained, and the trees resulting therefrom are making good growth. In the spring of 1925 about 4,000 almond blossoms were crossed. Although some of these were injured by frost, it is expected that many nuts will develop this season. The elimination of undesirable material can be made only after the trees have been grown and fruited for several years.

PECANS

In the winter of 1924 a collection of 144 pecan trees was obtained from different nurseries in Florida, Georgia, Alabama, Mississippi, Louisiana, and Texas and planted in permanent orchard form at the United States Pecan Field Station at Philema, Ga., for the purpose of determining the differences, if any, which may result from the use of trees varying in height, in diameter of trunk, and in length of taproot, as well as to determine the advantage, if any, of using seedling stock from nuts grown in different sections of the pecan territory. These trees are making a good growth this season, with no variations apparent that are traceable to the differences above enumerated.

Collections of nuts representing different varieties of pecans were planted in nursery rows in the winter of 1924 to produce seedlings for stock purposes, the object in part being to study their relative merits. Many of the seedlings burned off at the surface of the ground during the growing season of 1924. This injury was attributed to the extreme heat during the early part of the summer. It is of interest to note, however, that this injury was the most severe on seedlings from nuts produced in the eastern pecan section. Seedlings from nuts grown in Texas planted at the same time were little affected by the heat. A similar collection of seedlings from nuts grown at Hammond, La., was not seriously affected by the heat.

PERSIAN WALNUTS

A study of the blooming habits of several Persian walnut varieties in different sections was made. The young trees were found to produce fewer catkins than old trees in all cases, and in some instances young orchard trees were so devoid of catkins as to render pollination on a commercial scale impossible. Young trees of some varieties produced pistils scantily, whereas in other varieties pistils were in profusion. It is found that there is much difference in the relative time of development of the staminate and pistillate blossoms in different localities. Data collected indicate that in some cases the staminate catkins drop before the pistils are receptive to pollen, and lack of bearing to some extent can be attributed to this cause.

VEGETABLES

POTATOES

Oversized tubers.—In seasons when there is a large percentage of overgrown tubers the question is frequently raised as to their suitability for seed purposes. There is a strong prejudice against the use of such tubers for seed. A study to determine the value of overgrown tubers was undertaken in 1922 and has been continued in succeeding seasons. The results in 1924 corroborated those of the previous seasons and warrant the conclusion that the number of eyes on seed pieces from large tubers is less than on pieces of the same size from smaller tubers. The number of stems per hill is therefore fewer, resulting in a larger percentage of merchantable tubers. The only disadvantage in the use of large tubers is in the requirement of a greater number of bushels to plant a given area. This disadvantage may be more than offset by the fact that overgrown tubers have little or no market value for table purposes. Their use is mainly in the making of starch, although a profitable industry is developing wherein very large potatoes are sold at fancy prices for baking.

Certified seed.—About 180 strains of commercial varieties of certified seed potatoes were tested in 1924 at Aroostook State Farm, Presque Isle, Me., and a relatively small number at St. Albans, Vt., and Greeley, Colo. The tests in Maine in cooperation with the State department of agriculture proved of considerable value in connection with the market inspection service, as they supplied material for the study of the behavior of the different lots with respect to their freedom from disease and relative productiveness. They also afforded an opportunity for critical observation of the effectiveness and value of seed certification.

Virus diseases.—Studies of the virus diseases of potatoes (mosaic, leaf-roll, spindle-tuber, etc.) have been carried on during the past six years. As a result of these investigations the leading growers are now producing crops with a considerably lower percentage of these troubles, and seed-producing agencies, seed departments of potato growers' associations, and private concerns by following the general principles of seed improvement suggested are growing potatoes more nearly dis-

ease free than formerly. The progress of seed certification has also been very materially aided; from 15 to 30 per cent larger yields have been obtained from certified seed than from commercial stock. Some of the European forms of virus diseases are identical with American types, whereas others are distinct. It has been found that the transfer of juices of stems of apparently healthy plants to the stems of healthy plants of certain other varieties results in the appearance of pathological symptoms similar to, if not identical with, those which develop in the field in certain types of virus disease.

Storage.—Experiments to test the efficiency of different methods of storing potatoes were undertaken in the fall of 1924 in Aroostook County, Me., and continued during the following winter. The special object of these investigations was to determine the shrinkage of potatoes stored in different ways and their appearance when removed from storage for marketing. Two distinct bin structures were used in the storage work. One was a non-ventilated type of bin, the other ventilated. Ventilation was provided by means of double-slatted walls and a false floor, with a slatted flue passing through the false floor, extending up through the bin, and opening into the top of the storage chamber. The nonventilated bin was of ordinary construction, which did not allow any movement of air through or around it. The potatoes carried in the ventilated bins showed 6 per cent less shrinkage than those in the nonventilated bins in the same house. Moreover, in all comparisons when the stock was removed, that which had been stored in the ventilated bins had a much brighter and drier appearance than stock from the nonventilated bins. This better condition of the stock carried in the ventilated bins undoubtedly would have been reflected rather definitely in the market returns in any season when potatoes were bringing a reasonably good price. Because of the very large crop in 1924 and the depressed market the price for superior stock was little better than that for good ordinary merchantable material.

DASHEENS

A new variety of dasheen, the Sacramento, which has been under observation and test for several years and was distributed two years ago, is being marketed this season for the first time. The greater uniformity of

the tubers in size and shape not only makes the Sacramento easier to prepare for market but gives it a higher value than the Trinidad variety now generally grown. The bureau distributed small quantities of seed dasheens to experimenters in the spring of 1924. This phase of the introduction work is being gradually restricted, and it is expected that the demand for planting stock can soon be met almost entirely from commercial sources.

TOMATOES

In variety tests conducted in Florida and other Gulf States three new wilt-resistant varieties of tomato—Marvana, Marvelosa, and Marglobe—were found superior to Globe in resistance to nailhead rust and in freedom from puffy fruits. The Marglobe was most favorably commented upon by Florida tomato growers, as it is not only similar to Globe (the variety commonly grown there) in earliness, size, and shape of fruits, but produced 20 to 50 per cent more fruit than Globe. Moreover, the fruit was firm, approximately free from nailhead and other spots, and shipped and ripened well. The Marvana, the earliest of these varieties, has outyielded Marvelosa and Marglobe in most of the tests in the South, but its fruits are smaller and less globular than those of the other varieties. The Marvelosa has been favorably received by growers who produce their crop under glass or in trucking regions where the market demands place a premium upon pink fruits.

CUCUMBERS

Experiments have shown that the cucumber aphid after feeding on a mosaic plant can transmit the disease within a five-minute period of feeding on a healthy plant. Three to five aphids can produce infection as rapidly and consistently as a larger number. There is no evidence to indicate that the offspring of aphids fed on mosaic plants can transmit mosaic until after they have themselves fed on mosaic plants.

The experiment in Wisconsin on the control of cucumber mosaic by the destruction of wild hosts showed mosaic infection on September 1, 1924, to be 12 per cent, as compared to 100 per cent by August 20 for six seasons prior to the beginning of the experiment in 1923; also that a control field where no eradication was carried on became 100 per cent mosaic by August 15.

CELERY

Diseases.—The work begun two years ago at Sanford, Fla., in studying the effect of fertilizers on the black-heart of celery has progressed to the point where it has been shown that this disease is influenced more by the fluctuations in the water supply than by the fertilizers. It may be prevented by maintaining an adequate but not excessive uniform water supply throughout the growing season, avoiding an excess of moisture as the crop approaches maturity. There is a distinct varietal difference as to the susceptibility of varieties of celery to black-heart, Meisch's Special, or the so-called Pearly White strain, being more resistant than the Golden Self-Blanching strain. As a result of these experiments growers who in former years invariably suffered severely from the disease were able to carry their past season's crops through without loss.

The fertilizer results have nevertheless been of value to the growers, especially as to time and method of applications, when it is considered that in the Sanford region as much as 4 tons of fertilizer is used per acre. It is essential that fertilizer be of the proper composition to avoid injury. The experiments indicate that on land uncropped for several years an application of 4 to 5 tons of fertilizer per acre gives excellent results, but when the land is cropped successively a smaller quantity is sufficient to produce maximum yields. Many fertilizer ratios were included in the experiment, and the results indicate that a fertilizer lower in phosphate and higher in potash than has been customarily used is giving the best results in celery growing in this region.

Intensive experiments conducted to determine the efficiency of various copper-lime fungicide sprays in the control of the early-blight and the late-blight of celery in Florida resulted in the conclusion that homemade Bordeaux mixture is the cheapest and most effective spray material that can be recommended for controlling these diseases under the conditions prevailing in that State.

Transportation.—For some time there has been a controversy between the railroads, the refrigerator-car lines, and the shippers with reference to the so-called short car. The controversy, which appeared to hinge on the fact that the shipper can not place in the car the required load and have it arrive on the market in good condition,

attracted the attention of the Interstate Commerce Commission, and in an effort to get the facts of the case this bureau was asked to cooperate. Nearly every commodity loaded in these cars, according to the shippers, arrived in bad condition, but more serious difficulties were reported by the shippers of Florida celery than from any other source. For this reason celery was used as the commodity in the investigation undertaken by this bureau.

Under the present freight tariff 350 crates of celery are required for the minimum load, regardless of the length of the car. A refrigerator car of standard length carries this in a three-layer load, while the short car, which is 2½ feet shorter and equipped with the suspended wire-basket type of bunker having an ice capacity of 6,800 pounds, requires the load to be four layers high. A three-layer load in the short car accommodates but 294 crates. Shipping tests were made in which loads of 294, 315, 336, and 354 crates in the short cars were compared.

Study of the temperatures recorded in the cars and of the condition of the product in the several layers of crates at destination showed that when loaded only to three layers, to avoid crowding the upper crates too near the roof into the warmer zone of air always found in refrigerator cars loaded with warm produce, the short cars were as efficient as the others.

The temperature maintained in the short cars was as good as would be found in any other type of refrigerator equipment. It was found that even though the test trips were run at different times and under different outside temperature conditions the temperatures maintained in the cars were so nearly alike that for all practical purposes there was no difference, thus showing that there was no fault to be found with the efficiency of the short-type car when loaded according to the limitations indicated.

The results of these tests would seem to suggest that the transportation companies and the shippers should agree upon a different basis with respect to minimum-load requirements.

LETTUCE

The investigation of the brown-blight of lettuce has been continued in the Imperial Valley of California, and the fact that this disease is partly or wholly soil borne has been further verified. Selection and breeding work has resulted in the develop-

ment of several strains of the New York variety, which is grown almost exclusively in the West and sold in the eastern markets under the name Iceburg. These strains are apparently entirely immune to the disease. Three immune strains which are very uniform and commercially promising have been selected for increase. Seed of each of these strains is now available for a thorough commercial trial.

JERUSALEM ARTICHOKE

Though some work has been done with the Jerusalem artichoke from the variety or type and cultural standpoints during the past 10 years, it has been carried as a minor project. At the meeting of the American Chemical Society held at Ithaca, N. Y., September 8 to 13, 1924, a paper was presented by representatives of the Bureau of Standards in which a process for crystallizing granular levulose from a water solution of Jerusalem artichokes was announced, and a new interest was thus established in this crop as a possible source of sugar. It was therefore determined to expand the limited varietal collection of Jerusalem artichokes which had been brought together, to take varietal notes, and to grow seedlings.

During the fall and winter varieties of this artichoke were obtained from every known available source throughout the world, and these were planted at Arlington Experiment Farm in the spring of 1925. These various lots are being grown not only for perpetuation and increase where desirable but a quarter-acre lot of the Blanc Amelioré variety has been put in a permanent planting, where it will be allowed to remain for several years. Seeds were collected during the season of 1924 as opportunity offered. About 1,300 seedlings were grown in the greenhouse during the winter and early spring and transferred to the open in due course.

PEAS

Because of the importance of the Alaska variety of pea in the canning industry, tests were made of many lots of seed purporting to be of this variety obtained from different retail seedsmen. In the current season 203 samples of the Alaska pea were planted at Arlington Experiment Farm. A study of these as they developed revealed the fact that in the collection different lots varied all the

way from pure Alaska peas with no mixtures to those which contained not a single plant of the Alaska variety. Some stocks consisted of wrinkled table peas. The disastrous results which would follow the planting of such spurious or misnamed lots of seed if grown for canning purposes at once become evident. The Alaska is grown very largely for canning because of certain peculiar characteristics which it possesses. Most other varieties, and particularly the wrinkled table peas, have these characteristics so slightly or not at all that they would be of practically no value from the standpoint of the commercial canner.

During the season of 1924 more than 400 varieties and strains of peas were planted in a trial plot located at McMillan, Mich., to secure as full and comprehensive notes on the pea varieties in cultivation as possible. This work is continued during the current season and includes several hundred newly purchased samples of pea seed from foreign sources. In the selection work special attention is being given to the Alaska variety, with a view to segregating particularly promising strains or types.

PEANUTS

Seed stock of five standard varieties of peanuts, both shelled and unshelled, has been stored at 36°, at 40° F., and at room temperature, or what might be termed "natural storage." These lots of seed were planted and germination counts and yield records made. The results of this work, continued now for four consecutive seasons, show that under the conditions of the experiment cold storage of the seed does not affect either germination or yield.

Comparable lots of five varieties of seed stock have been shelled each month, beginning with December and continuing until planting time, the seed shelled at different times being stored under the same conditions as unshelled seed. The results show that within the time and other limits of the experiment there are no appreciable differences in germination and yield.

With respect to the oil content, the time of harvesting has a large controlling influence, within relatively narrow limits. For example, a difference of 10 days in the time of harvesting may make a difference of 10 per cent in the oil content.

CEREALS

WHEAT

Cultural experiments.—Experiments conducted during the past six years at Arlington Experiment Farm on rates and dates of seeding and on seed-bed preparation for winter wheat indicate that disking the seed bed after a cultivated crop is preferable to plowing, on account of the smaller expense involved. The yields that follow disking are slightly but not significantly higher than on plowed land. October seeding at the rate of 6 pecks per acre appears best.

Winter wheat sown with the furrow drill at Moccasin, Mont., showed an increase in yield over that sown with the ordinary drill. Sowing with the furrow drill decreased the injury to wheat from freezing and soil blowing. As a result of these experiments furrow drills are being used on many farms in central Montana.

Grading the seed wheat used has had no effect on yields at Arlington Experiment Farm. Large seed sown at the rate of 6 pecks per acre and small seed at the $4\frac{1}{2}$ -peck rate produced practically identical returns, although plats sown with the small seed had more plants per acre in the fall.

No beneficial results were obtained from electrochemical treatment of seed wheat, contrary to claims made by commercial promoters in England.

Determinations of the dry weight of wheat seedlings 4 to 10 weeks old, grown from seed treated with uspulun, semesan, germisan, formaldehyde, mercuric chloride, and silver nitrate, compared with plants from untreated seed, indicate that none of these treatments stimulates germination or seedling growth.

Rosette.—Investigations conducted in cooperation with the Wisconsin and Illinois Agricultural Experiment Stations have shown that the rosette of wheat is caused by a virus which is capable of existing for extended periods in certain soils. The same virus may cause either (1) a characteristic mosaic mottling of wheat leaves or (2) the extreme dwarfing of plants and the bluish green coloration of leaves which previously had been considered the principal manifestations of the rosette. Certain susceptible varieties of winter wheat, such as Harvest Queen, when grown in infested soil may show both sets of symptoms. Other varieties, such as Currell, when similarly grown,

show only the leaf mottling. The mottling also has been noted on winter rye. Artificial inoculations of Harvest Queen wheat with the virus from mosaic-infected Currell wheat have produced the dwarfing and bluish green coloration characteristic of rosette. By the use of this same virus artificial inoculations of Harvest Queen and Currell wheat and winter rye also have produced the characteristic mosaic-leaf mottling on all three hosts. Several satisfactory varieties already are known to be resistant to rosette. The resistance of these varieties to mosaic-leaf mottling, as well as the relation of this mosaic disease of winter wheat and winter rye to the mosaic diseases of other plants, requires further investigation.

Black stem rust.—Grains and grasses near infected barberries become rusted two or three weeks before any rust appears on more distant grains and grasses. A heavy rust infection on spring wheat in central North Dakota in 1924 was immediately traceable to about 80 barberry bushes near Jamestown which had been overlooked in the original survey. The occurrence of stem rust on oats over an area more than 60 miles long in western Wisconsin was directly traceable to infected barberries in an area of escaped bushes near Trempealeau.

Before the removal of such great numbers of barberry bushes it was almost impossible to differentiate between the local stem-rust epidemics which the infected barberries caused. Now that so many millions of these bushes have been removed the local epidemics are greatly reduced in number and are identified much more easily. Within the last year it has been possible to find great numbers of barberry bushes by tracing stem-rust epidemics from areas of light infection to areas of heavier infection until the source of the epidemic was reached. This has been true in practically every State of the eradication area. It seems probable that when the common barberry bushes in the 13 States are reduced to such a minimum that each local epidemic can be clearly isolated from the other epidemics, each bush in a year favorable to the production and spread of stem rust eventually will reveal its location.

Barberry eradication.—The campaign to remove all of the common barberry bushes to control black stem rust of wheat in the 13 North-Central grain-growing States has completed its seventh full year. The agricultural colleges of these States, the State de-

partments of agriculture in most of them, the Conference for the Prevention of Grain Rust, and similar allied agricultural and business organizations are cooperating in the campaign.

A determined effort has been made to discover and treat all escaped barberry bushes. One of the outstanding discoveries of the year's work is the fact that the areas of escaped bushes in nearly every instance are larger than was at first supposed. A total of 3,860,402 escaped bushes and 4,631,929 escaped seedlings have been found since the beginning of the campaign. Of these, 259,733 bushes and 806,451 seedlings have been found this year. The grand total of bushes, sprouts, and seedlings found during the entire campaign is 11,277,387.

CORN

As in recent years, the investigations on the production and improvement of corn have been centered chiefly on corn breeding, although experiments on cultural practices, varietal adaptation, and agronomic technique also have been conducted in cooperation with various State agricultural experiment stations. In the south-central section of the Iowa corn-yield test, conducted cooperatively by the Iowa Corn and Small-Grain Growers' Association, the Iowa Agricultural Experiment Station, and this bureau, four of the five leading strains were first-generation crosses between self-pollinated lines. The most productive, an entry by this bureau, yielded 51.33 bushels of shelled corn per acre as compared with 39.10 bushels from the best of the 17 standard varieties of corn that were represented. This increase exceeds 30 per cent.

Some of the strains and varieties introduced during the previous year from high altitudes in the Andes were shown to grow well in this country at temperatures below those necessary for the normal development of our domestic varieties. This high-altitude corn, which requires a relatively long season to mature, has been crossed with extremely early varieties from North America in the hope of obtaining types having the ability both to grow well at relatively low temperatures and to mature ears quickly.

BARLEY

Seed-treatment experiments with barley at Arlington Experiment Farm in 1924, as in previous years, showed that the organic mercury compounds, including Corona No. 620, germisan,

semesan, and uspulun, gave very satisfactory control of both loose and covered smut and stripe disease and did not cause as much seed injury as formaldehyde treatment. The dust treatment again failed to control these smuts.

Most striking is the discovery that infection of loose smut may be produced by spores applied externally to barley seed. Heretofore the only known means of infection was through the flowers. Greenhouse experiments in which dehulled seed of susceptible varieties of winter barley and of the resistant variety Nakano Wase were inoculated with spores of loose smut produced smutted plants from the susceptible varieties but smut-free heads on the resistant variety. Seedlings from both susceptible and resistant varieties, however, were severely injured and many failed to emerge. In the susceptible varieties the fungus apparently was able to grow with the barley plant, whereas in the resistant variety it died before producing smutted heads.

OATS

Two new high-yielding strains of oats developed in the cooperative experiments at Cornell University and tested on New York farms have been named Ithacan and Upright. These are in addition to the Comewell, Cornelian, Empire, and Standwell, similarly developed and distributed to New York farmers a few years ago. The Ithacan has a white kernel and has been one of the most productive strains in tests conducted on New York farms. The Upright was distributed primarily because of the demand for a very stiff strawed variety for growing on dairy farms.

In a survey of oat varieties made by the Iowa Agricultural Experiment Station in 1924 it was estimated that the four improved varieties—Albion, Richland, Iowar, and Iogren—previously developed in cooperative experiments with that station were grown on 46 per cent, or nearly one-half, of the oat acreage of Iowa in that year. Approximately 1,350,000 acres were devoted to Albion, 800,000 acres to Iowar, 500,000 acres to Richland, and 50,000 acres to Iogren, a total of 2,700,000 acres. These new oats, particularly the Albion and Iowar, have become important commercial varieties in other States adjoining Iowa and also in Illinois.

In cooperative experiments at the Kansas Agricultural Experiment Station inoculating the dehulled seeds with smut produced much higher per-

centages of infection of susceptible varieties than inoculation without removing the hulls. When resistant varieties like Kanota and Burt were so treated, however, only a small increase of infection was obtained.

RICE

One of the chief needs of the rice industry in California has proved to be new varieties maturing early enough to escape injury from early fall rains while still standing or in shock. As the commercial rice of California is of the Japanese or short-grain group, early-maturing varieties must be looked for in Japan. Especial effort has been made to obtain such varieties, and 265 lots were received in time for growing under detention at Arlington Experiment Farm in the spring of 1925. Of these, about 75 or 80 already were being tested at the rice experiment farm at Crowley, La. The others were brought directly from Japan. No rice diseases have been introduced into the California rice fields, and growing these new varieties in detention insures that they will be free from disease when sent to California for testing next year.

SUGAR PLANTS

CANE

Despite the disastrous flood at Canal Point, Fla., in October, 1924, a number of new sugarcane seedlings were produced, and about 300 of them survived. These are all from parents which are immune to or tolerant of mosaic, the disease which is responsible for much curtailment of sugarcane yields in Louisiana. Approximately 1,300 seedlings produced in previous years were given preliminary trials, and a large proportion of them have been discarded. About 500 promising ones were sent to field stations in Georgia and Louisiana for further trial. Performance records of about 5,000 sugarcane seedlings in various stages of testing are now on hand.

One of the imported varieties being tested in Louisiana, P. O. J. 234, proved decidedly better than those which for a considerable period of years had become established as the leading commercial varieties, and this was distributed to nearly 3,000 planters in the Gulf States. The distribution of 52 half-ton lots of the same seed cane by the American Sugar Cane League was also supervised. Work in importing, testing, and distributing this variety, which is extremely re-

sistant to mosaic and root disease, is an outstanding accomplishment.

Many data on the environmental conditions which operate to accelerate deterioration of seed cane by fungi and bacteria were collected as a result of storage experiments during the winters of 1923-24 and 1924-25. One of the interesting facts brought out is that constant temperatures just above freezing are not favorable for cane storage. Work on the root disease of sugarcane was started in May, 1924, and the discovery was made that under local conditions the predisposing cause of this disease is the attack of an extremely small subterranean snail. The life history of this snail was studied, tests were made demonstrating its ability to cause great damage, and experiments to determine possible control methods were begun.

BEETS

Cooperative work on sugar-beet breeding and field practices has been carried on with the Michigan Agricultural College. Several hundred new isolations of selected mother beets were made in the fall of 1924. These are being tested in comparison with a large number of strains of European origin. Many of the selected strains are better in both yield and quality than beets from commercial seed.

Studies of the storage of mother beets have been carried on at Salt Lake City, Utah. Large losses of sugar due to respiration and other physiological activities of the plants occur during storage of the beets. As a result of these studies improved methods for the selection of stored mother beets have been devised.

Several species of predacious and parasitic nematodes were found attacking the sugar-beet nematode in Utah. For the intermountain region practicable rotations have been established which control the development of nematodes sufficiently to prevent appreciable loss in yield. These rotations have been strongly indorsed by field managers of sugar-beet companies and by leading growers.

Several new and important facts with regard to the spread of curly-top were brought out during the year. One of these, the attenuation of the virus of curly-top by being passed through certain wild hosts, has an important bearing on observations of the severity of the disease in commercial plantings.

The investigations with sugar-beet fertilizers in the Arkansas Valley show that the soils respond markedly

to fertilizers, particularly those carrying phosphoric acid. The sugar content of the beets is being raised and the production greatly increased wherever fertilizers of suitable composition are used. For example, the use of a small quantity of phosphate of low price has increased the yield of beets on certain soil types as much as 100 per cent. All types of soil in this region do not respond equally to this treatment, and a study of the relationship of soil type to fertilizer treatment is in progress. Sugar-beet fertilizer investigations of a preliminary character have been begun in other regions of the western sugar-producing States, Colorado, Michigan, Nebraska, and Utah. In some sections the most satisfactory results follow the use of potash fertilizers.

DRUG PLANTS

LEVANT WORMSEED

The possibility of growing Levant wormseed (*Artemisia cina*) in certain sections of the United States as a commercial crop has been considered. This plant is the source of the important vermifuge santonin. The present source of this plant is Turkestan and Persia, and the importation of santonin has been so reduced in recent years that it commands an exceedingly high price. The plant has been grown successfully for several years at Chico, Calif., which indicates that it will probably thrive in the hot interior valleys of California.

INSECT-POWDER FLOWERS

A greater demand for insect flowers (*Chrysanthemum cinerariaefolium*) in the future is indicated by the results obtained in recent years with extracts of these flowers used as sprays and promises to extend greatly the usefulness of this valuable insecticide. Since the admixture of some stems and leaf material with the flowers does not preclude their use for the manufacture of spray preparations, it is probable that the method of harvesting this crop may be greatly simplified by the use of machinery, thus greatly reducing the cost of production. One-quarter of an acre of insect flowers was grown at Arlington Experiment Farm, and the quantity of flowers harvested indicates an approximate yield of 300 pounds of dry flowers per acre for the first crop, with the second and third crops somewhat larger.

SAFFLOWER AND HEMP

Experiments in growing safflower (*Carthamus tinctorius*) seed and Manchurian hemp (*Cannabis sativa*) seed in the northwestern grain belt indicate that these crops may become valuable sources of oils to supplement the production of linseed oil. Acre trials in North Dakota, South Dakota, and Wyoming indicate that 20 to 30 bushels of safflower per acre may be expected in favorable seasons. Plantings of both crops are being increased and extended over a larger area. Laboratory studies of the safflower and hemp oils have indicated that paints prepared with either of these oils are less subject to yellowing than when prepared with linseed oil, a characteristic which naturally enhances the value of these oils.

ROSE GERANIUM AND LEMON GRASS

The cultivation of perfume plants, such as rose geranium and lemon grass, is being extended on a semi-commercial scale in Florida and California in cooperation with the Association of Manufacturers of Toilet Articles. It has been demonstrated that lemon grass will grow well in central Florida, where 3 acres of this plant are under cultivation. Samples are declared by the trade to be equal to the imported oil. According to preliminary trials, southern California appears to be an ideal place for rose geranium, and the planting of several acres to demonstrate its possibilities in that section is contemplated.

FORAGE CROPS

LEGUMES

Alfalfa.—Considerable quantities of alfalfa seed have been imported into the United States during the year. Much of this seed has come from Canada, but very large importations have been received from Argentina, France, and South Africa, with smaller quantities from Italy and other European countries. Such tests as have been made indicate rather definitely that most of the alfalfas from Argentina and South Africa are not sufficiently hardy for our Northern States, although giving fairly good results in the Southwest. In no case has seed from either of these sources proved superior to that of adapted strains of American-grown alfalfa. It is believed that a considerable part of the winterkilling in the Northern States during the past few years may be at-

tributed to the use of seed from Argentina, South Africa, or from some other source producing alfalfas no more resistant than such strains to the cold.

The possibility of determining the region of production of any lot of seed imported through the occurrence of incidental seeds is of growing agricultural importance, since seeds of some of our important field crops from certain regions are not adapted to general agricultural use in the United States. Outstanding examples are red-clover seed from Italy and alfalfa seed from Turkestan.

Ladak alfalfa, a new variegated strain introduced from northern India through the efforts of the United States Department of Agriculture, is still proving somewhat superior to any other variety for parts of the northern Great Plains, especially where the rainfall is rather limited. Efforts are now being made to increase the seed of this alfalfa, and it is hoped that it will soon be available commercially.

Crimson clover.—Tests which have been in progress for four years at numerous points in the Southeastern States indicate that seed of crimson clover from France and central Europe may give as good results as domestic-grown seed. Seed from Italy and England has not been wholly satisfactory, while a number of late varieties, both red and white flowered, have been nearly valueless. Outstanding success has been achieved in obtaining stands of crimson clover with seed sown in the hull. An inquiry is in progress to determine the best methods of harvesting, cleaning, and sowing this unhulled seed.

Samples of crimson-clover seed were collected from seed dealers in June and tested for germination. The results indicated that the seed kept over from the season of 1924 was of higher germination than that which was being imported during the present season.

Field peas.—Tests of the Gray Winter field pea for two years have practically demonstrated its value as a substitute for hairy vetch in the Southeastern States. This variety is being imported by a seed firm in New York under the name of Austrian Winter field pea. It is hardy along the Atlantic coast as far north as the District of Columbia and can be seeded in the fall and grown as a winter cover and green-manure crop in much the same manner as hairy vetch, with yields fully as large. At Washington, D. C., when sown October 15 to 20, it is ready to plow under or cut for hay

from May 25 to June 30. In South Carolina and Georgia it can be sown one month later and is ready to cut a month or six weeks earlier than at Washington. One of the most important aids to agriculture in the Southeastern States would be a winter-growing legume having seed abundant and cheap which can be plowed under early enough in the spring to be followed by corn or cotton or used for hay, if occasion demands. The Gray Winter field pea, unlike hairy vetch, produces seed abundantly in South Carolina and seems to fill the requirements more nearly than any legume so far discovered.

Soybeans.—Owing to increased demands for information on the culture, varieties, and harvesting of soybeans and the greater use of this crop and its by-products, more extensive investigations have been undertaken. The large increase in acreage and production of seed, the demand for cooperative variety tests over the country, and the greater utilization of the crop for forage, pasture, and the production of oil and oil meal emphasize this increased interest. Cooperative variety tests with standard sorts and varieties developed by the bureau were carried on throughout the entire country, and requests for similar tests were received from about 15 foreign countries. About 350 introductions were recently received from experiment stations and agricultural colleges in China, Japan, Manchuria, and Chosen (Korea). More than 1,200 individual plant selections were made in 1924 from crosses, introductions, and standard varieties to aid in the development of pure strains suitable for forage, ensilage, pasture, grain, oil, and human food in different sections of the United States.

Velvetbeans.—The development of new varieties of velvetbeans of bush habit and with white seeds has continued on an extensive scale. Several selections developed through the crossing of early sorts with the bush variety showed pure lines of white seed and bush habit with the pods held higher than those of the standard bush variety, the pods of which lie close to the ground. A few of these selections gave very promising results, and sufficient seed was obtained for larger tests and for seed increase. The development of a white-seeded bush variety is highly desirable, as the seed of the bush variety now on the market is indistinguishable from the standard vining sorts. The Arlington and Tracy, early-maturing strains devel-

oped by this bureau, gave excellent results in extensive tests. The Tracy variety gave excellent yields of forage and seed, and the Arlington, maturing earlier than any standard variety, indicated that the velvetbean area can be extended appreciably northward.

TURF GRASSES

The finest of the grasses for growing the highest quality of turf are the bent grasses, particularly creeping bent (*Agrostis stolonifera*), seaside bent (*A. maritima*), velvet bent (*A. canina*), and Rhode Island bent (*A. tenuis*). These prove to be far superior to the fescues, the only other grasses that compare with bent in making fine turf. All of the species mentioned have numerous strains, varying in qualities such as color, texture, and disease resistance. All of them succeed best on soils that are decidedly acid in character, and where the acidity is fairly high such admixtures as chickweed and white clover disappear and annual weeds like crabgrass and goosegrass no longer invade the turf. In other words, the whole matter of weeds in fine turf can be regulated by controlling the chemical reaction of the soil.

The most useful of all the grasses for the fine turf desired on golf courses is creeping bent, and more than 100 strains of this grass were selected. The most valuable have been named Washington, Metropolitan, Virginia, and Revere. These grasses all produce stolons 3 to 5 feet in length. By growing nursery rows and then planting the chopped-up stolons, a very superior turf, uniform in color and texture, is obtained. Where seed is used, such complete uniformity is unattainable. This vegetative method of growing the creeping bents has now been widely commercialized, about 20 different firms being engaged in the business. Thus far the demand for the material has been mostly from golf clubs, but to a considerable extent the grass is now being used for lawns.

The preferred four strains mentioned are almost entirely resistant to the brown-patch fungous disease, which causes extensive damage to varieties that are not resistant. This disease (*Rhizoctonia solani*) can be controlled fairly well by frequent spraying with Bordeaux mixture but more satisfactorily with the chlorophenol-mercury compounds. The disease appears during the warm season, June to September. There are two forms, large brown-patch and small brown-patch; but it is not determined

whether the organisms connected with these two diseases are different or simply phases of the same species.

ENFORCEMENT OF THE SEED-IMPORTATION ACT

During the fiscal year 1925, samples of 1,888 shipments of seed were examined. More than 40,000,000 pounds of seed was permitted entry, and about 1,250,000 pounds, or about 3 per cent of the seed imported, was prohibited. Of this prohibited seed approximately 40 per cent was that of red clover, largely of Chilean origin, which was rejected on account of the presence of dodder.

During the year 76,000 pounds of refuse was destroyed under customs supervision, and 211,000 pounds of prohibited seed was returned to the countries from which it came.

The seed-importation act is largely self-enforcing, as relatively little seed is offered for import which does not comply with its requirements. In the case of most shipments which have been rejected, the quality was little below the minimum required; so that by careful recleaning the greater part of these shipments has been made to comply with the requirements of the act.

The total importations subject to the seed-importation act for the fiscal year 1925 were much less than in the previous year, the most notable reductions being in red-clover seed (nearly 25,000,000 pounds being imported in 1924 and approximately 6,500,000 pounds in 1925) and alfalfa seed (nearly 13,000,000 pounds being imported in 1924 and less than 5,000,000 pounds in 1925). Smaller reductions occurred in crimson clover, rape, English ryegrass, sweetclover, and hairy-vetch seed.

NEMAS PARASITIC IN INSECTS

Until recently little was known about the minute nematode worms sometimes infesting American grasshoppers. Two of these nemas prove very interesting and are of economic significance in that they are important factors in the birth rate of grasshoppers, so much so that were it not for these parasites there is strong reason to believe that certain grasshoppers would be a perennial plague. Up to the present time infestation has been found in such important species as the eastern red-legged locust and its relatives and the clear-winged locust of the Northwest. When nematized—and sometimes practically every hop-

per is nematized—these hoppers produce fewer or no eggs. These particular nemas are classed as mermithids, of which no species in this country, until the inception of these researches, had been even adequately described.

In the study of the Mermithidæ, parasites of insects, spiders, millepedes, and snails, explorations as to distribution, both general and local, were made, showing the presence of these parasites over large areas. The highest infestation of 1924 (about 50 per cent) was found in Whitman, Mass. In connection with this infestation a temporary nematorium was constructed at Whitman and stocked with about 5,000 grasshoppers, insuring plenty of material for the study of life histories.

Large open-air cages in the vicinity of Washington, D. C., have also been heavily stocked with grasshoppers collected from mermithid-infested areas with a view to keeping hosts and parasites under close observation, to establish colonies, and to put life-history information to a practical test under natural conditions, thus making possible continued study during the winter.

FIBER PLANTS

COTTON

Northward extension of cotton culture.—Improved varieties and methods are making it possible to grow better crops of cotton under short-season conditions and thus to extend the range of profitable cultivation along the northern rim of the Cotton Belt. In southern Virginia, in parts of Tennessee and Kentucky, and even in southern Illinois, cotton is being planted in new districts or in larger acreages, and the same is true to an even greater extent west of the Mississippi. The most notable extension has occurred in the Plains regions of northern and western Texas and the adjoining districts of Oklahoma and New Mexico. The rainfall of this region is precarious, but good crops of cotton are produced in favorable years, and the danger of complete failures in dry seasons is reduced by close spacing or by the entire omission of the thinning or chopping operation, which also reduces the cost of production. Thus it may be expected that the northern and western extensions of the Cotton Belt may appreciably affect the volume of cotton production in the United States if the price relations continue favorable for a few years.

Superior varieties.—No other problems of improvement are more important

than to extend and establish the utilization of better varieties of cotton. During the period of the weevil invasion new varieties have been bred or acclimatized from Mexico and Central America which are earlier and more productive than the inferior short staples and mixed stocks that still form the bulk of the American cotton crop.

The production of the very short and irregular staples in the United States is in direct competition with other inferior cotton from India and China and tends to restrict prices, but such competition could be avoided by discarding the inferior stocks and establishing a regular production and marketing of superior varieties. There is no advantage in producing cotton of less than 1-inch staple in any part of the American Cotton Belt. The lack of supplies of pure seed is the chief limitation to the use of superior varieties, and the cotton-breeding work of the department is centered on the problem of seed supplies of such varieties as Acala, Lone Star, and Kekchi.

The general improvement of production now possible is going forward in some regions by the use of superior varieties and by adopting the system of community production, with a single variety in each neighborhood or district. Under the community system the stocks of pure seed are maintained and increased in quantities sufficient for general use instead of planting different varieties indiscriminately with the resulting mixture and rapid deterioration of the seed stocks.

Interest in cotton improvement has developed in California to the point of establishing one-variety conditions in several districts, so that it now becomes possible to increase the supplies of pure seed of the Acala variety to an extent that has not been practicable with any other. At the last session of the legislature of California an act was passed for the protection of one-variety communities, making it illegal to bring in seed or to plant, cultivate, or harvest any other variety of cotton in several counties where the Acala variety is being grown exclusively. The pure-seed districts have the direct advantage in producing and marketing a definitely standardized crop, while supplies of pure seed will also be available for other districts, so that a wider utilization of this superior variety becomes possible.

The Acala variety is well adapted to conditions in Oklahoma, Texas, and Arkansas and has been grown exten-

sively, but adequate seed stocks have not been available in one-variety communities for lack of the necessary conditions of production. Since the community conditions afford the best assurance of establishing and maintaining large stocks of pure seed through periods of years and of developing other improvements of production, special cooperation is being given to the communities growing Acala cotton in California. The uniformity and other superior qualities of the Acala fiber are being recognized in the textile centers of England and France, as well as in the United States, so that a more active market may be expected for Acala cotton than for other Upland varieties. Premiums of several cents per pound are being obtained through the production of commercial quantities of uniform Acala cotton in the irrigated valleys of the Southwest.

A revival of interest in Pima cotton in the Salt River Valley, Ariz., is shown by an increase in the area planted, from 8,000 acres in 1923 to about 40,000 in 1924. Upland cotton was grown in all parts of the valley last year, and this has resulted in the planting of a great deal of mixed seed. This bureau, in cooperation with the Maricopa County Farm Bureau Pure-Seed Association, the county agent of Maricopa County, and the University of Arizona, is endeavoring to remedy this situation and provide the growers with pure seed of Pima cotton for planting.

The Smooth Seed strain of Pima yielded the same as the commercial stock of this variety in an alternate-row yield test at Sacaton. The absence of fuzz on the seeds almost doubles the outturn of the roller gins, and the fiber comes off the rolls in better condition. On the other hand, spinning tests conducted by the Bureau of Agricultural Economics have indicated that yarns made from the Smooth Seed Pima are slightly weaker than yarns made from the present commercial stock of the variety. It is desirable, therefore, to test the Smooth Seed Pima further before a decision is reached as to the advisability of its commercial production. Meantime isolated fields of Smooth Seed Pima, comprising in all about 150 acres, are being grown for seed increase.

At present a detailed comparison of Pima Egyptian and Sea Island cotton is under way. Comparisons are being made of four Upland varieties—Acala, Lone Star, Meade, and Durango. Of these Acala is now the most impor-

tant Upland cotton grown in irrigated regions.

Closer spacing.—It is recognized that the greatest advantages of close spacing of cotton are shown under boll-weevil conditions or where the seasons are very short, but experiments do not show that wide spacing is preferable even where the seasons are very long. A test of this problem was made with Acala cotton in the Coachella Valley in southern California. Repeated comparisons of 2-inch, 6-inch, and 12-inch spacings under long-season conditions showed that the yields from the different spacings were nearly the same, and the relatively slight differences that occurred were in favor of the closer spacings, at 2 or 6 inches. The results of closer spacing are approximated where two or more plants are left together in hills at 12 to 15 inches. It is being recognized by farmers that the former custom of wide spacing of individual plants not only was a waste of labor but often had the effect of reducing the crop, especially with open or irregular stands.

Planting machinery.—Further consideration has been given to the problem of obtaining more uniform stands of cotton, especially in the dry regions and irrigated districts of the Southwestern States. The two principal difficulties are the drying out of the surface soil before germination is completed and the failure of the seedlings to emerge from a hard crust if the soil is moistened by rain or by irrigation water. Experiments that were reported in 1916 and 1917 showed some of the advantages of placing the seed closer to the irrigation furrows, but on account of the lack of suitable machinery the improved methods have not been applied. The development of improved machinery was interrupted in the war period.

Recently it has been possible to return to this problem, and a workable attachment for cotton planters has been devised, for which a public-service patent has been requested. To replace the usual devices for covering and pressing the soil above the seed, a heavy roller is applied directly to the seeds to embed them in the moist soil, with only a light covering of dry soil above. It was recognized as a limitation of existing types of planting machines that the seeds were dropped into the loosened soil of the planting furrow instead of being placed in a regular and effective relation to the soil moisture or to the supply of irrigation water.

Root-rot.—Root-rot of cotton is prevalent and often very destructive in some of the chief centers of production in the Black-Land Prairie region of Texas. Many experiments have been made in the hope of discovering methods of control, but the results usually have been negative or indefinite. Experiments in Arizona have shown that the fungus may be killed, at least in small spots, by saturating the soil with formaldehyde solution and that applications of farmyard manure may reduce the mortality of cotton from root-rot or postpone the injuries till later in the season, so that larger yields are obtained. Fallowing and rotation with grass crops, which are not affected by root-rot, have been considered as methods of control but often have not proved effective. A practical limit to the survival of the fungus is indicated by the results of an experiment with a plat of badly infested root-rot land at Greenville, Tex. A thoroughly clean fallow in which no weeds or grasses were allowed to grow was maintained for two seasons, as it is possible that dead grass roots might keep the fungus alive in the soil, although grasses are considered immune to root-rot. Cotton was grown on this plat in the season of 1924 with no indication of the survival of the fungus in the soil, in striking contrast with adjacent plats, which showed the usual root-rot injuries.

FLAX

Saginaw.—The Saginaw variety, which has been developed by selection begun in 1909, is more uniform, taller, and more resistant to drought than any of the unselected commercial varieties of fiber flax. The fiber is of excellent strength, but a little coarse. It does very well for most of the linen manufactures of this country, for no very fine linen yarns are made in America. Further selections are being made to obtain a strain with finer fiber which will retain the superior qualities of the Saginaw. More than 1,000 acres of this variety are being grown this season by commercial fiber-flax growers in eastern Michigan and in Oregon. The seed will be carefully saved to increase the stock of this variety.

Retting.—Cultural and morphological studies of flax-retting organisms and numerous tests of these in retting flax have resulted in definite information that flax is retted not by one organism but by many. The nature of the principal organisms and also the temperatures and some of the other controlla-

ble conditions under which they are most efficient in retting flax have been determined. The studies thus far have been made in the laboratory. For practical value the information thus gained must be applied to tank retting.

ABACA

In a field investigation early in 1924 it was found that two diseases, heart-rot and root-rot, had completely destroyed abaca plantations in Cavite and Laguna Provinces in the Philippine Islands, which include the abaca areas nearest to Manila, though relatively unimportant and in soil and climate not so well adapted to abaca as the larger areas farther south. Unconfirmed reports were received that these diseases were widely distributed and in some places destructive in other Provinces. In a careful survey made in the first half of 1925 in all the important abaca-producing districts, evidence of one of the diseases was found in only one small area, and it has been exterminated there. The planters have been warned, and a careful watch is being kept, so that it is hoped that these or other diseases may be stamped out before they become firmly established.

RUBBER

TROPICAL SPECIES IN FLORIDA

It has been determined that several rubber-producing species of plants grow well and could be utilized in the United States, but other species or varieties may be found that yield more or better rubber or that are better adapted to cultivation under our conditions. On account of the great number of species that contain rubber, it is a large undertaking to make experimental determinations of the various possibilities that exist, to choose the plants best adapted to our conditions, and to develop suitable cultural methods and extraction processes.

Several of the tropical rubber-producing species thrive in southern Florida and appear to be so well adapted to local conditions that extensive cultivation might be possible. The Assam rubber tree (*Ficus elastica*) and the purple-flowered rubber shrub (*Cryptostegia grandiflora*) are widely distributed and grow very well in many localities in the southern half of Florida. *Cryptostegia madagascariensis* has also been introduced into Florida; this species has been studied in Mexico and Haiti and is known to produce rubber of fair quality. Healthy seedlings of the Para rubber

tree have been grown at the United States Plant Introduction Garden, Chapman Field, near Miami, and are being transplanted to different conditions of soil and exposure. The collection of rubber plants now growing at Miami includes numerous species of *Alstonia*, *Asclepias*, *Carissa*, *Carpodinus*, *Castilla*, *Cerbera*, *Cryptostegia*, *Euphorbia*, *Ficus*, *Funtumia*, *Hevea*, *Jatropha*, *Landolphia*, *Manihot*, *Mascarenhasia*, *Parthenium*, *Pedilanthus*, *Plumeria*, *Rhabdadenia*, and *Urceola*.

While the East Indian plantation system of production apparently would not be feasible in Florida on account of the high cost of labor, it is not impossible that other systems and methods of production and extraction of rubber might be developed that could be established as regular agricultural industries. Popular interest in such possibilities of development in southern Florida is very acute among the thousands of new settlers who are now establishing themselves in the more tropical districts. Although private cooperation might contribute to earlier solutions of the experimental problems, commercial plantings of rubber can not be considered advisable until practicable methods of handling the crop under Florida conditions have been devised and demonstrated.

DESERT TYPES IN CALIFORNIA

Rubber plants that are natives of dry regions are being tested in California, in the coast districts as well as in the interior valleys. Several dry-country rubber plants are known in Mexico, while others are reported in South America, Africa, and Madagascar. The production of rubber from the Mexican guayule plant (*Parthenium argentatum*) has been investigated carefully by a private corporation, and the stage of agricultural practicability is believed to have been reached in California.

The more pronounced desert types of rubber plants are being grown in the lower valley of the Colorado River, near the Laguna Dam. Special attention is being given to one of the native species of milkweed (*Asclepias subulata*), which appears to be the most promising from the standpoint of growing on waste lands and of producing the largest quantity of rubber-bearing material readily and cheaply. Explorations have shown that the natural distribution of the species covers a rather wide range of conditions, indicating that cultivation might extend over large areas if methods of utilization were perfected. The

plant is widely scattered in southern Arizona and the adjacent desert regions of Sonora and southern California, but it has also been traced in Lower California to a locality a few miles south of Ensenada, where it grows in small ravines or gullies of barren hillsides a few miles from the coast. The largest individual plants, with hundreds of stems forming dense masses more than 6 feet high and 10 feet across, have been found in valleys of the San Jacinto Mountains, near Palm Springs, Calif.

TAPPING IN HAITI

The East Indian tapping methods have been applied experimentally to a small planting of *Hevea*, about 20 years old, near the north coast of Haiti. The records of these experiments are comparable with those that have been reported from the East Indies and show the same wide range of variation in the production of latex from individual trees. From 60 to 75 per cent of the rubber is produced by 25 per cent of the trees in the East Indian plantations, and the problem of producing uniformly high-yielding trees is still to be solved. Some of the trees in Haiti approached the best records in the East Indies, whereas others yielded very little latex and some none at all. The seasonal variation in the flow of rubber is much greater in Haiti than in the East Indian plantations, so that continuous tapping would not be practicable during the dry winter months. Other systems of production in which continuous tapping would not be necessary must be considered. Undoubtedly the trees could be grown and the rubber extracted much more cheaply by the native landowners than under a plantation system.

EXPERIMENTS IN THE CANAL ZONE

Plantings of all available species of rubber plants are being made in the Canal Zone in cooperation with the experimental garden of the Canal Zone Government at Summit, near the middle of the Isthmus. By permission of the United States War Department a tract of 10 acres on the Atlantic side of the Isthmus, at the Fort Sherman Military Reservation, has been made available for experimental plantings of rubber on lands that are being drained to control mosquitoes and that afford conditions apparently very similar to those of the locality where *Hevea* rubber thrives in Haiti. From seed beds to be established in

these or in other suitable places, it is expected that seedlings of *Hevea* can be transplanted, at least in small numbers, to many localities that can be selected to represent the full range of conditions in the Canal Zone and adjacent districts of Panama to determine the practicability of commercial plantings of rubber or of utilizing waste lands for reserve plantings from which emergency supplies can be drawn.

FOREST-TREE DISEASES

The most commonly known of the diseases that kill forest trees are two which have been imported: The chestnut blight, which is completing the destruction of our chestnut forests, and the white-pine blister rust, for which the bureau has been able to develop practicable control methods. Numerous native American killing diseases take a toll which is less spectacular, but in the aggregate heavier.

The chronic weakening diseases which slow down wood growth are very numerous and difficult to study. In addition to the fungi which cause such diseases, there is in the West a group of inconspicuous leafless mistletoes which have been found to greatly reduce both the quality and quantity of timber produced.

The best-known timber diseases are the heart rots, which destroy wood after it has been formed. Careful statistical studies on important western timber species and less complete data from the East indicate that nearly one-sixth of the apparent wood volume in our standing timber is worthless because of heart-rot.

A type of fungous injury related to the decay of the heartwood of trees is the destruction of forest products. Of the annual cut of about 22,000,000,000 cubic feet of wood from the forests of the United States, it is estimated that about 3,750,000,000 feet go to replace wood that is rendered valueless by the action of fungi. This represents a replacement cost for material alone of more than \$400,000,000 a year. The proportion of loss was at one time materially higher than at present. It has been decreased by the application of methods of decay prevention which have been in large part the outcome of the cooperative work of this bureau and the Forest Service. By further investigation and educative effort an additional decrease of 1,500,000,000 cubic feet in our annual loss from decay of forest production can be effected. This would be the

equivalent of a 25 per cent increase in our producing forest area.

For diseases which attack forest nurseries, direct-control methods have been devised and are now in process of refinement. Diseases of older trees can be controlled in a large measure when the trees are grown for shade or ornament, but under the conditions obtaining in forests special control is rarely possible. The control of white-pine blister rust, aside from fire control the greatest single achievement in the history of forest protection, is the only case in which a disease in the forest has been successfully handled by special methods. It has been found, however, that the native diseases which have been most studied can be in large part controlled by modifications in methods of forest management. Such modifications have already been put into effect in sales operations on the national forests. When the thorough investigation of the diseases of each of the more than a hundred important American forest species has been completed, it will be possible to put into the hands of foresters practicable methods for very material reduction in the losses from forest diseases of all types.

WHITE-PINE BLISTER RUST

The cooperative programs for the suppression and control of white-pine blister rust in the Eastern and Western States have made satisfactory progress.

Control in the East.—Control of the disease is accomplished by systematically eradicating the alternate host plants, *Ribes* (currants and gooseberries), within a short radius of white-pine stands. The distance varies with local conditions, but ordinarily does not exceed 900 feet. Each year numerous individuals and many townships contribute to the cooperative funds and join in the control work. This has resulted in the application of control measures on 2,385,494 acres of land, at an average acre cost of 18 cents. As a result of the extensive experiments in control practices conducted prior to 1922 in cooperation with the affected States, 1,061,991 acres of land were freed from *Ribes*, so that the total area on which control measures have been applied is 3,447,485 acres.

Control in the West.—Scouting in British Columbia during the past year showed no further extension of blister rust. This was probably due primarily to the dry weather conditions that

prevailed in the Northwest. Additional pine infections were found in western Washington, indicating that the rust is slowly establishing itself on the native pine host in this region.

Cultivated black currants have been largely eradicated in western Montana, Idaho, Washington, Oregon, and northern California. This species (*Ribes nigrum*) has been the principal medium through which the disease has spread from infected to healthy pines in widely separated regions. It becomes diseased at great distances from infected pines and then infects less susceptible species of near-by currants and gooseberries. In this manner disease centers are established, from which the rust spreads locally to other kinds of currants and gooseberries and to white pines.

The department recognizes the black currant as a distinct menace to the white-pine timber supply of the country. It so seriously threatens the production of five-needled pines as to make it a public nuisance in all States where these trees grow. The department is opposed to the growing of this currant anywhere in the United States and recommends that State authorities, nurserymen, and growers take active steps to eliminate it from the Pacific, Rocky Mountain, Atlantic, Appalachian, Ohio Valley, upper Mississippi Valley, and Lake States.

Supplementing the eradication of cultivated black currants, blister-rust quarantines have been maintained to prevent the spread of the rust into disease-free regions through the shipment of infected host plants.

Experimental work in developing and applying control practices has been carried forward on the Kaniksu National Forest in northern Idaho during the past year. The results obtained have been favorable and indicate that protective measures can be worked out and applied at costs which will make control practicable under western conditions.

CHESTNUT BLIGHT

Survey work to determine the present status of the chestnut-blight infection was conducted in 175 counties in the southern Appalachian region during the past fiscal year. The disease is spreading rapidly over this area. The finding of a large advance infection covering thousands of acres in the northwestern part of Georgia and the southeastern part of Tennessee, a region which was thought to be very lightly infected, shows that field inspection in each county is necessary.

Preliminary forecasts have been made as to the time of death of the chestnut timber in different parts of the southern Appalachians. These forecasts are being used by State and Government authorities and by private owners as a basis for the utilization of standing chestnut.

The propagation of oriental *Castanea* and *Castanopsis* species has been continued with a view to producing a large number of plants for distribution to cooperative experimenters in the study of the various species with regard to their ability to become established and thrive in regions where the chestnut blight has destroyed the native chestnut. *Castanea mollissima*, which has shown partial resistance to this disease, has been propagated in large quantities, and about 10,000 small trees are on hand and will be available for experimental plantings in 1926. Collections of promising new species of *Castanea* and *Castanopsis* have been assembled and placed in permanent plantings during the year for future breeding and related work.

LOSSES FROM DECAY

Eastern hardwoods.—Preliminary studies, particularly of oak timber, show that even to a greater degree than among the western conifers forest fires are the most important single cause of decay in eastern hardwoods. Fires which fail to kill the tree scar the butt, and through these scars decay enters and continues for years. Thus the greatest damage of a fire may not be apparent until the tree is cut, 50 or 100 years after the fire has occurred. A preliminary survey indicates a loss of 19 per cent from decay in eastern hardwoods.

Fallen timber.—The studies of the rate of deterioration of down timber in the forests have been extended in the Northwest, where a single storm caused wind throw of timber worth approximately \$9,000,000. Contrary to the ideas previously accepted, it has been found that the fallen timber of Sitka spruce, Douglas fir, silver fir, western red cedar, and western hemlock has not decayed after four years, the only damage from fungi being loss in grade of sapwood because of blue stain. On the other hand, fallen western yellow pine has been found to decay rapidly, requiring immediate utilization.

Pulp wood.—Experiments to control the molding and rotting of wood pulp have repeatedly proved that sodium fluoride is one of the most efficient preservatives known for this type of

material, and its use is thoroughly practicable on a mill scale. Studies of the pulping qualities of infected wood have been continued. The results indicate that although it is possible to make a fair grade of pulp from certain types of infected wood the better policy is to expend more effort in the control of decay on the siding and in the storage yard. A mill-scale experiment has been begun for the purpose of observing the relation of moisture-content changes and the rate of deterioration in stored hemlock pulp wood.

Sitka spruce.—After a number of years of study satisfactory methods have been devised for investigating the effect of fungous infection on the mechanical properties of wood. The study has been conducted with the Army and Navy Air Services. Particular attention has been paid to the change in mechanical properties of Sitka spruce. The results of the study indicate that a comparatively new type of test, known as the toughness test, which can be easily and quickly made, is most satisfactory for measuring the change in shock resistance which results from fungous attack. Fungi affect the wood in different ways. The common red-heart fungus (*Trametes pini*) is much less destructive in its early stages than fungi of the brown-rot type. Important relations between loss in specific gravity and loss in strength have been established for certain fungi, and it has been proved that measurements of specific gravity have no value in estimating strength properties in the case of infected wood.

PLANT NUTRITION

CONCENTRATED FERTILIZERS

An investigation has been undertaken to study the effect of concentrated fertilizer salts, such as would be manufactured by plants like that at Muscle Shoals, Ala., already being offered extensively in the fertilizer trade by foreign competitors. Mixtures made from these concentrated salts present new problems to the American fertilizer industry and to American agriculture. At present Germany is offering for sale in the United States large quantities of such materials. Moreover, about half the world's fixed-nitrogen supply is derived from the atmosphere by chemical-fixation processes.

It has become necessary to study in a preliminary way the problem of uniformly applying these highly concentrated materials in the field and to

investigate also their effect on germination and the possible injury to the growing crop due to the great concentration of salts and their physiological effect on young plants. The physical character of many of these concentrated salts also presents problems in mixing and conditioning the fertilizers for use with existing fertilizer-distributing machinery. The rate of distribution and the placing of the salts in the soil, whether under, alongside, or above the seed, will also have to be considered. The results obtained will have an important bearing on the general question of fertilizer production by such plants as that at Muscle Shoals.

FERTILIZERS FOR TOBACCO

In the Coastal-Plains section of the flue-cured tobacco district of North Carolina fertilizer experiments have indicated that in general the best results may be obtained with a fertilizer containing approximately the equivalent of a formula analyzing 8 per cent phosphoric acid, 3 per cent ammonia, and 4 or 5 per cent potash, applied at the rate of 1,000 pounds per acre. On many of the soils provision also should be made for supplying in the fertilizer or otherwise small quantities of magnesia, perhaps 10 to 20 pounds per acre when applied in the row. The indications are that the ammonia in the fertilizer should be derived partly from organic and partly from inorganic sources. The use of cyanamid as the sole or chief source of ammonia commonly results in injury to the tobacco crop.

In southern tobacco districts where commercial fertilizers are extensively used the comparative merits of sulphate and muriate as sources of potash for tobacco have come to be a matter of considerable importance to both the fertilizer manufacturers and the farmers. Field tests have definitely shown that the muriate may often give somewhat better yields than the sulphate. On the other hand, the muriate in comparison with sulphate has an appreciable injurious effect on the combustibility of the tobacco. To this extent the general use of the muriate will tend to restrict the use of such tobacco in the production of smoking tobaccos and cigarettes. It would seem, therefore, that the safer practice would be to use a mixture of sulphate and high-grade muriate in such proportions that the content of available potash in the fertilizer would be at least double the content of chlorine.

In the new bright-tobacco district of southern Georgia results of tests to date show that on fresh land the chief response is obtained from phosphorus as a fertilizer element, whereas on the older land potassium and nitrogen are the elements most needed. For average conditions a fertilizer analyzing 8 per cent phosphoric acid, 3 per cent ammonia, and 5 per cent potash, applied at the rate of 1,000 pounds per acre, is recommended on the basis of available data. Better results are obtained when this fertilizer is supplemented by 1 to 2 tons of manure applied in the drill.

Brown root-rot of tobacco causes heavy losses every year, especially in the Connecticut Valley, where the application of intensive methods, involving continuous cropping to tobacco and very heavy fertilizing, frequently results in failure of the tobacco crop to develop normally. Results of recent field-plot tests seem to indicate that the disease is of a nonparasitic nature and is a result of the chemical properties of certain soils. It has been found that the system of cropping has a remarkable effect on the severity of the disease, and certain crops which themselves seem to be immune may greatly aggravate the injury to susceptible crops which follow them in rotation. It has been discovered that drying or aerating the soil may largely eliminate the disease. Apparently the remedy lies in the application of suitable cultural practices and the use of proper cropping systems. In general, the usual types of crop rotation adapted to soil improvement are not applicable.

ORGANIC SOILS

Truck-crop production.—The investigation of truck-crop production on organic soils, which has been in progress for several years, was continued on the same basis, and the following indications seem to be warranted:

(1) A rotation is desirable to keep muck soil supplied with decaying vegetable matter, largely for the purpose of preventing wind damage. Careful attention to surface drainage, especially the supplying of provision for the rapid removal of excessive rainfall, is necessary, as standing water is extremely injurious to vegetable crops. Windbreaks in the form of strips of protective plants set at right angles to the direction of prevailing winds are necessary on large muck areas.

(2) Lime is without beneficial effect and may even be injurious when applied to onions, celery, lettuce, and cabbage on the types of muck used in this work. Applications of potash to these crops growing on the same types of muck are profitable. Applications of phosphate as well as nitro-

gen do not give profitable responses with the same vegetables.

In the greenhouse tests at Arlington Experiment Farm mixtures of one-eighth to one-fourth, by volume, of organic soil from either Indiana or New Jersey with ordinary greenhouse loam have given yields of roses and carnations comparing favorably with those obtained by the use of the usual loam employed in greenhouse work. The results with tomatoes indicate that any considerable quantity of muck in the soil is likely to produce a heavy vegetative growth with a small yield of tomatoes.

Peat.—The peat deposits of Maine and Vermont have been examined. Along the eastern coast of Maine occur unusual dome-shaped areas of peat which have not been encountered anywhere else in this country. In type of profile they are the counterpart of the European high moors. The elevated mass consists almost entirely of sphagnum peat, which is similar in character to the material imported from Europe in increasing quantities for litter, composting, and other purposes.

Detailed information upon the agricultural and industrial value of peat land in 13 States is now available. The chemical qualities of different types have been studied, especially with the view of differentiating between stages of decomposition in peat material.

Photographic illustrations to identify the several kinds of peat layers and series of type profiles to indicate the differences between peat lands for various uses have been published. Information upon various peat problems has been furnished to soil surveyors, drainage and highway engineers, cranberry and truck-crop growers, and to foresters engaged in improving the growth of timber on waste swamp land.

SOIL BACTERIOLOGY

Bacteria and crop growth.—Increases in cereal crops that can be obtained by including suitable legumes in the crop rotation are much less due to a direct fertilizing effect of the legumes than to their beneficial effect upon the microflora of the soil. In the fields where the legume hays on surface growth were cut and removed, the corn crop following was frequently twice or three times as large as that after cereals or even after fallow. More total nitrogen and more nitrate nitrogen were found in soils planted alternately to cereals and to legumes. The

number of bacteria and of fungi growing in these soils was markedly increased, and nitrifying and nitrogen-fixing soil organisms displayed greater activities. Legumes turned under as green manure gave very little or no increase, never more than 10 to 15 per cent above that recorded where the surface growth or legume hay was removed. In their beneficial effect upon the succeeding corn crops the legumes included in this test ranged in order as follows: Canada field peas, hairy vetch, cowpeas, and soybeans. Their influence upon the microflora of the soil was found to range in the same order. Maximum increases were recorded when the corn crop was planted 10 weeks after the legumes had been cut. Shorter as well as longer intervals resulted in smaller increases and limited the favorable change in the biological conditions of the soil. These observations help to explain why in practical farming most satisfactory results are obtained if leguminous catch crops are grown between cereal crops in such a manner that the field is left bare only a very short time.

After 10 years' testing, the annual application of 30 pounds of mineral nitrogen has reached a rather low efficiency, whereas an equivalent quantity of stable manure, which could be produced from the legumes grown as catch crops, has gradually increased in nitrogen efficiency to approximately twice that of nitrate and ammonium nitrogen. Since the leguminous catch crop by its beneficial influence upon the productivity of the soil likewise causes a marked increase in the succeeding corn crop, it becomes very evident that the proper use of catch crops and stable manure can very efficiently help to maintain and restore the natural productivity of American soils and to produce larger crops at very moderate cost.

Inspection of cultures.—In examining commercial cultures for legume inoculation 5 out of 14 brands were found to be of poor quality, and the firms responsible for their manufacture have been advised.

Four inoculants for nonlegumes have been found on the market in the United States. These have been tested or are under test at the present time. None have given the results claimed for them, and two have been found to be practically worthless. Two foreign nonlegume inoculants, the promoters of which are seeking a market in America, are being examined.

EFFECT OF LIGHT PERIODS

As a feature of the investigations of the effect of relative length of day and night on plant growth, field tests have been conducted at Arlington Experiment Farm and elsewhere to obtain information as to the significance of this factor under practical growing conditions in controlling the time of flowering and fruiting of certain types of plants and their adaptability to different latitudes. In plantings of medium and late maturing varieties of soybeans made at frequent intervals through the growing season and covering a period of five years there has been in all cases a close correlation between the prevailing length of day and the length of the vegetative period. Variations in temperature and other environmental factors from year to year have only hastened or delayed flowering by a few days, and in no case has the controlling influence of the length of day been seriously disturbed. For example, in the vicinity of Washington, D. C., the Biloxi variety regularly flowers in early fall rather than in midsummer, for the reason that the summer days are too long, whereas the Peking variety regularly flowers late in July, because it responds to a somewhat longer day, but is prevented from flowering by the longest days of early summer. Moreover, with increase in latitude the time of flowering of both varieties is correspondingly delayed, whereas with decrease in latitude the opposite is true. Very early varieties, on the other hand, are not particularly sensitive to change in length of day, so that the length of the vegetative period is not greatly affected by the date of planting.

DRY-LAND AND IRRIGATION AGRICULTURE

MAINTENANCE OF HOMESTEADS

In the Great Plains area lies a vast empire of more than 400,000 square miles. The difficulties of its agricultural problems, based on the unusual climatic conditions prevailing there, are commensurate with its territorial greatness. Progress must of necessity be slow, but solutions are being discovered and will continue to be discovered as the reward of patient, intelligent methods of attack, until its mighty potentialities for good are released. During the past three years the possibilities of home making on the Great Plains have been brought more closely to the attention of farmers

than any other phase of agriculture in that region. Once it is demonstrated that the maintenance of self-sustaining homesteads is not only possible but practicable in that vast region, the results can not but be beneficial and far reaching.

Work with that object in view has been productive of encouraging results and has reached the stage to justify the conclusion that homes can be established and families maintained from the returns of fruits and vegetables of the farm under all growing conditions. Shelter-belt trees are an important factor in making this possible. In previous years soil blowing presented a very serious problem, which has now been practically solved through the protection afforded to crops by shelter belts supplemented by proper cultural treatments of the soil. The shelter belts not only protect the crops, but afford the shade and comfort associated with the country home. Years of experiment in developing trees adaptable to that region under the cooperative shelter-belt distribution conducted at the United States Northern Great Plains Field Station, Mandan, N. Dak., have produced trees that can be grown successfully in the region. Farmers are realizing the importance of shelter belts, and there is now a demand for trees that exceeds the supply.

Upon a 1-acre plat sufficient vegetables can be grown to support a family of five. These results with fruits and vegetables are significant. They mean that the food requirements of a family are assured from the farmstead. Add to such a farmstead a cow or two, a litter of pigs, and a flock of poultry, and a competent farm economy is accomplished. The attractive and happy farmsteads provided with these resources that are beginning to dot the prairies in the Plains region fully compensate for the years of labor by the investigators of the department and augur well for the future. Any permanent agriculture must plant its roots around the nucleus of the farm home. When communities of farm homes are once established the expansion of farm activities for supplying staple crops for the market on a large scale will develop as the capital of each farmer increases and experience guides his industry and initiative.

An important contribution resulting from the activities of the investigators of the department is that colonization committees and railroad companies in the Plains region now have

for their information reliable data upon its agricultural possibilities and limitations. They have facts to act upon rather than the chimeras and unhealthy speculations of past decades. The many requests for information received from prospective settlers as well as from those interested in the sale of land furnish ample evidence that this information is being utilized.

SUSTAINED PRODUCTIVITY OF IRRIGATED LAND

The agronomic work conducted at the field stations of the bureau where irrigation is practiced affords a means of understanding some of the fundamental factors that determine whether or not irrigated land will continue productive for a long time. In view of the large investment of capital and labor required to provide irrigation water and to develop irrigated land, it is essential that such land shall be highly and continuously productive. The fact that in many sections land has become unproductive after a few years of irrigation is the chief basis for the relatively high cost of credit for operations on irrigated land. In the absence of a clear understanding as to why some irrigated lands are highly productive and others are not, the development of such lands must continue to be a speculative enterprise.

The chief hazards in irrigation, aside from those common to ordinary farming, may be grouped into three classes: (1) The accumulation in the subsoil of excessive quantities of water, (2) the accumulation in the soil of the root zone of excessive quantities of soluble salts, and (3) changes in the physical condition of the soil by which it becomes impermeable to the movement of water and consequently unproductive because it does not absorb the irrigation water applied to it. These three difficulties may occur together, or any one of them occurring alone may cause disastrous results.

The accumulation of injurious quantities of subsoil water has been thought to be due chiefly to the excessive use of irrigation water by farmers. The evidence now available indicates that it is due rather to percolation losses from canals and ditches. The present need is to decide in each case the chief source of the water causing the injury. This decision may make it possible to prevent trouble by less expensive and more effective means than drainage.

The accumulation of soluble salts in the surface soil or root zone to the point of injury to crop plants may come about in either of two ways. Where the subsoil is saturated with water so that the surface soil is kept moist from below, continued evaporation results in concentrating the soil solution past the limit of tolerance of crop plants. On the other hand, a similar condition may result where the subsoil is not saturated. When irrigation water is used so sparingly that all the water applied is held within the root zone, to be absorbed by plants or lost by evaporation, then the salts carried in solution in the irrigation water remain in the root zone and in time make the soil solution too concentrated for crop use.

The changes in the physical condition of the soil in the direction of impermeability are the result of reactions that take place between the soil and the salts in the soil solution. When the salts in the soil solution are chiefly salts of sodium the reaction

with the soil is in the direction of replacing calcium from combination with the soil. The sodium passes into soil combination and the replaced calcium passes into solution, and accordingly may be more or less rapidly leached. Soils containing appreciable quantities of combined sodium as a result of such replacement reactions become dispersed and gelatinous when wet, do not absorb water readily, and become hard when dry.

A clear understanding of the nature and causes of these three classes of trouble that may develop on irrigated land makes it possible to anticipate the difficulties before they have progressed to the point of serious injury. It is much less difficult and less expensive to prevent these troubles than to work out remedies after the injury has been done. Furthermore, a better understanding of the conditions where any or all of these troubles may be expected will give a better basis for credit conditions on those irrigated lands where such conditions do not exist.

APPENDIX

The following classified list of separate publications and contributed articles written by workers in the Bureau of Plant Industry comprises those issued during the year ended June 30, 1925:

FRUITS

- Breeding work with reference to citrus stocks. *In* Proc. Fla. State Hort. Soc., v. 37, p. 25-29.
- Bud selection as related to quality of crop in the Washington Navel orange. *In* Jour. Agr. Research, v. 28, p. 521-525.
- Investigations of the freezing of citrus fruits. *In* Calif. Citrograph, v. 10, p. 181-182.
- Borax as a disinfectant for citrus fruit. *In* Jour. Agr. Research, v. 30, p. 189-196.
- Preliminary results with the borax treatment of citrus fruits for the prevention of blue mold rot. *In* Jour. Agr. Research, v. 28, p. 961-968.
- Preliminary results with the borax treatment of citrus fruits for the prevention of blue mold rot. *In* Citrus Indus., v. 6, no. 3, p. 10, 30-31, 34.
- Commercial control of citrus melanose in Florida in 1923. *In* Proc. Fla. State Hort. Soc., v. 37, p. 127-129.
- Relation of environmental factors to citrus scab caused by *Cladosporium citri* Massee. (With Ala. Agr. Exp. Sta.) *In* Jour. Agr. Research, v. 28, p. 241-254.
- Further studies on the relative susceptibility to citrus canker of different species and hybrids of the genus *Citrus*, including the wild relatives. (With Ala. Agr. Exp. Sta.) *In* Jour. Agr. Research, v. 28, p. 227-239.
- Marking of oranges and grapefruit. *In* Fla. Grower, v. 30, no. 15, p. 5, 15.

- Transportation of citrus fruit from Porto Rico. U. S. Dept. Agr. Bul. 1290.
- Apple growing east of the Mississippi River. U. S. Dept. Agr., Farmers' Bul. 1360.
- Preliminary report upon the influence of climatic conditions on the ripening processes in apples. *In* Proc. Amer. Soc. Hort. Sci., v. 20, p. 108-113.
- Freezing injury of apples. *In* Jour. Agr. Research, v. 29, p. 129-136.
- An apple stem-tumor not crown gall. *In* Jour. Agr. Research, v. 27, p. 695-698.
- Oiled paper and other oiled materials in the control of scald on barrel apples. *In* Jour. Agr. Research, v. 29, p. 129-136.
- Diseases of apples on the market. (With Bur. Agr. Econ.) U. S. Dept. Agr. Bul. 1253.
- Morphological character of *Alternaria mali* Roberts. *In* Jour. Agr. Research, v. 27, p. 699-708.
- The isolation and identification of quercetin from apple peels. *In* Jour. Agr. Research, v. 28, p. 1243-1245.
- Experiments in the propagation of fruit-tree stocks. *In* Proc. Amer. Soc. Hort. Sci., v. 20, p. 241-244.
- A new Chinese peach, *Amygdalus hansenii* (Rehder) Skeels. *In* Proc. Biol. Soc. Wash., v. 38, p. 87.
- Plum and prune growing in the Pacific States. U. S. Dept. Agr., Farmers' Bul. 1372.
- Prune and cherry brown-rot investigations in the Pacific Northwest. U. S. Dept. Agr. Bul. 1252.

- Diseases of stone fruits on the market. U. S. Dept. Agr., Farmers' Bul. 1435.
- Two hitherto unreported diseases of stone fruits. *In Jour. Agr. Research*, v. 28, p. 603-605.
- The life history of the grape rootrot fungus *Roesleria hypogaea* Thüm. et Pass. *In Jour. Agr. Research*, v. 27, p. 609-616.
- Leather rot of strawberries. *In Jour. Agr. Research*, v. 28, p. 357-375.
- The Rhizoctonia brown rot and other fruit rots of strawberries. *In Jour. Agr. Research*, v. 28, p. 643-648.
- Managing cranberry fields. (With Mass. Agr. Exp. Sta. and Wis. Cranberry Exp. Sta.) U. S. Dept. Agr., Farmers' Bul. 1401.
- Field observations of false blossom of the cultivated cranberry. *In Phytopathology*, v. 15, p. 85-91.
- Notes on blueberry and cranberry diseases. *In Proc. Amer. Cranberry Grow. Assoc.*, v. 55, p. 7, 10.
- Dewberry growing. U. S. Dept. Agr., Farmers' Bul. 1403.
- The Young dewberry, a new hybrid variety. *In Amer. Fruit Grow. Mag.*, v. 45, no. 1, p. 9, 33.
- Blackberry growing. U. S. Dept. Agr., Farmers' Bul. 1399.
- Blackberry varieties. *In Amer. Fruit Grow. Mag.*, v. 45, no. 4, p. 5, 14.
- The Van Fleet raspberry, a new hybrid variety. U. S. Dept. Agr., Dept. Circ. 320.
- Cytological studies of diploid and polyploid forms in raspberries. *In Jour. Agr. Research*, v. 27, p. 737-748.
- The spraying of black raspberries. *In Amer. Fruit Grow. Mag.*, v. 45, no. 2, p. 20, 23.
- Grossularia echinella, a spiny-fruited gooseberry from Florida. *In Jour. Agr. Research*, v. 28, p. 71-74.
- Viburnum americanum as a garden fruit. *In Proc. Amer. Soc. Hort. Sci.*, v. 20, p. 44-54.
- Physalospora malorum on currant. *In Jour. Agr. Research*, v. 28, p. 583-587.
- Occurrence of the currant cane-blight fungus on other hosts. *In Jour. Agr. Research*, v. 27, p. 837-843.
- Botryosphaeria and Physalospora on currant and apple. *In Jour. Agr. Research*, v. 28, p. 589-598.
- Botryosphaeria and Physalospora in the eastern United States. *In Mycologia*, v. 17, p. 98-107.
- El cultivo y explotación de la higuera en Norte-américa. *In Hacienda*, v. 19, p. 274-277, 306-310.
- The fungus causing the common brown rot of fruits in America. *In Jour. Agr. Research*, v. 28, p. 955-960.
- Aecidiospore discharge as related to the character of the spore wall. *In Jour. Agr. Research*, v. 27, p. 749-756.
- Expulsion of aecidiospores by the mayapple rust, *Puccinia podophylli* Schw. *In Jour. Agr. Research*, v. 28, p. 923-926.
- Uninucleated aecidiospores in *Caecoma nitens* and associated phenomena. *In Jour. Agr. Research*, v. 28, p. 1045-1058.
- Mixing emulsified mineral lubricating oils with deep-well waters and lime-sulphur solutions. U. S. Dept. Agr. Bul. 1217.
- Pecan scab with special reference to sources of the early spring infections. *In Jour. Agr. Research*, v. 28, p. 321-329.
- Apparent limitations to pecan-scab control. *In Amer. Nut Jour.*, v. 22, p. 41-42.
- Black walnut for timber and nuts. (With Forest Service.) U. S. Dept. Agr., Farmers' Bul. 1392.
- Chinese walnut situation. *In Ann. Rpt. West. Nut Grow. Assoc.*, v. 6, p. 4-7.

VEGETABLES

- Studies on the potato tuber. *In Jour. Agr. Research*, v. 27, p. 809-835.
- Size of potato sets: Comparisons of whole and cut seed. U. S. Dept. Agr. Bul. 1248.
- Good seed potatoes for the home garden. *In Better Homes & Gard.*, v. 3, no. 3, p. 14-15.
- Como se produce la buena semilla de papa. *In Agricultura* (Santiago de las Vegas), v. 2, no. 3, p. 4-8.
- The potato of romance and of reality. *In Jour. Heredity*, v. 16, p. 113-126.
- Potato observations abroad. *In Proc. Potato Assoc. Amer.*, v. 11, p. 123-129.
- Sterility in potatoes. *In Science*, v. 61, no. 1570 (Suppl.), p. xii, xiv.
- Why potatoes run out. U. S. Dept. Agr., Farmers' Bul. 1436.
- Methods to be observed to prevent spread of virus diseases in potatoes grown for seed stock. *In Proc. Potato Assoc. Amer.*, v. 11, p. 20-26.
- Seven years tests with commercial dusting materials against potato blight. *In Proc. Potato Assoc. Amer.*, v. 11, p. 86-92.
- Deux ans d'essais de culture de quelques variétés françaises de pommes de terre en terrain contaminé par le Synchronium endobioticum, à Freedland (Pennsylvanie). *In Rev. Path. Vég. & Entom. Agr.*, v. 11, p. 93-98.
- The respiration of potatoes in storage. *In Potato News Bul.*, v. 2, p. 109-110.
- Low temperature injury to potatoes in storage. *In Proc. Potato Assoc. Amer.*, v. 11, p. 54-59.
- Pythium rootlet rot of sweet potatoes. *In Jour. Agr. Research*, v. 29, p. 53-55.
- Storage of sweet potatoes. U. S. Dept. Agr., Farmers' Bul. 1442.
- A Chinese potato bean. *Glycine fortunei* (Maxim.). J. B. Horton. *In Proc. Biol. Soc. Wash.*, v. 38, p. 88.
- The dasheen; a southern root crop for home use and market. U. S. Dept. Agr., Farmers' Bul. 1396.
- Taros and yautias; promising new food plants for the South. U. S. Dept. Agr. Bul. 1247.
- Sclerotinia intermedia n. sp., a cause of decay of salsify and carrots. *In Phytopathology*, v. 14, p. 323-327.
- Studies on disease resistance in the onion. *In Proc. Nat. Acad. Sci.*, v. 11, p. 183-189.
- A fusarium bulb rot of onion and the relation of environment to its development. *In Jour. Agr. Research*, v. 28, p. 683-694.
- Further studies on the toxicity of juice extracted from succulent onion scales. *In Jour. Agr. Research*, v. 30, p. 175-187.
- Further studies on the relation of onion scale pigmentation to disease resistance. *In Jour. Agr. Research*, v. 29, p. 507-514.
- White rot of Allium in Europe and America. *In Phytopathology*, v. 14, p. 315-322.
- Greenhouse tomatoes. U. S. Dept. Agr., Farmers' Bul. 1431.
- The control of tomato leaf-spot. U. S. Dept. Agr. Bul. 1288.

NUTS

- Hardiness in nut trees. *In Rpt. Proc. North. Nut Growers Assoc.*, v. 15, p. 127-135.
- Almond varieties in the United States. U. S. Dept. Agr. Bul. 1282.
- Utilization of almonds for various food products. U. S. Dept. Agr. Bul. 1305.

- Tomato wilt and varietal resistance. *In* Seed World, v. 17, no. 5, p. 7-9.
- Dodging wilt with resistant tomatoes. *In* Pacific Rural Press, v. 109, p. 39.
- Verticillium wilt of tomato. *In* Phytopathology, v. 15, p. 187-188.
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¹ These supplements, although mimeographed statements, form a more or less permanent record of the status of crop diseases. The Plant Disease Reporter is a biweekly news bulletin issued during the growing season from June to November to keep pathologists and others informed concerning disease conditions and developments in various parts of the United States. By means of it State pathologists are able to keep in touch with conditions in surrounding States and with important new developments. During 1925 volume 8 of the Reporter, containing 12 numbers and 147 pages, was issued, and two numbers of volume 9. The Reporter is now being sent to 633 individuals, institutions, and libraries.

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REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE.

Washington, D. C., October 10, 1925.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1925.

Respectfully,

WILLIAM B. GREELEY,
Forester.

Hon. W. M. JARDINE,
Secretary of Agriculture.

FOREWORD

This report renders an account of stewardship. Public and contributed moneys disbursed for the activities of the Forest Service itself and for the execution of work which it directs or in which it participates totaled \$23,540,000; public properties having a total area of 158,000,000 acres were administered. What was obtained in return for these expenditures and what was done in managing these properties the everyday taxpayer and plain citizen has a right to ask and be told.

The report must necessarily deal mainly with live problems and matters of current interest. Brevity compels the omission of descriptions of general procedure, since this is not a handbook of information on administrative aims, methods, and policies, but an account of progress. Many questions which will naturally suggest themselves concerning the how and why of things neither can nor should find answer here. Otherwise each annual report would largely repeat that of the year before. Supplementary information will gladly be furnished on inquiry; much is embodied in other service publications.

For 20 years the Annual Report of the Forester has sought to provide a current record of progress and accomplishment not only in the work of the Forest Service but also in national forestry. The activities and aims of the service can be gauged correctly only when seen against the background of the general forest situation and needs of the country.

NATIONAL PROGRESS IN FORESTRY

The forestry movement began in this country as a protest against the loss of natural resources. There was wide concern that the timber supply was being eaten into at an accelerating rate, but little conception of practical ways to check its depletion. After an early period of wavering and ineffective legislation the first practical steps of any real value were taken through provision for public agencies of investigation to learn something about the actual facts. There followed the initiation of constructive management of forest lands by the National and by State Governments, and a promotive or educational effort to introduce forest protection and private reforestation from the top down. Constructive public leadership in these fields has borne fruit.

The most significant change in our forest situation within recent years is the degree to which timber growing has become a matter of general interest and understanding and a use of the soil actually applied by private agencies. Forestry is at last making real headway in the United States in the shape of a gradual evolution in industrial practice and land management. To this evolution public leadership, current public opinion, and economic forces are now all contributing. National progress in forestry will from now on be measured, most of all, by the rate at which timber growing becomes part of every-day land usage. Of this outward spread of forestry there is marked evidence in current trends.

THE SPREAD OF PUBLIC INTEREST

The degree and breadth of public interest in forestry is unquestionably greater now than ever before in the history of the country. And this interest is shown along constructive lines. Acceptance of the fact that forestry is unquestionably an urgent public need has become virtually universal. There is better appreciation than at any former time of what forestry actually is—use and timber cropping; not abstention from use and tree worship. And there is not merely a receptive readiness to learn more but also an eager desire for information on possibilities and practices.

Both the agricultural and the general press welcome and seek such information in volume far beyond the ability of the Forest Service to make it available. The daily mail discloses a like demand from individuals. Speakers on forestry are desired for public assemblages; educational motion pictures and exhibits are constantly sought for purposes of instruction, to an extent wholly out of proportion to the supply; popular publications can not be prepared and printed to keep pace with the call for them; demonstrations and practical advice are wanted on every hand. The extension services and State foresters are experiencing and so far as possible responding to this call. But if there is any saturation point of the public mind on matters relating to forestry it is so entirely beyond view that for immediate and practical purposes it does not come into the reckoning.

This broadening and deepening of public interest—this eagerness to know more and, if it proves feasible, to do more—presents a unique opportunity. To meet and take advantage of it there are many agencies besides the Forest Service. The State foresters and State extension services have been already mentioned. The professional forest schools and the departments of forestry now established in a number of our universities and colleges are playing their part, and the agricultural colleges are moving toward the place that they must have in the picture.

Indeed, the extent to which new agencies are entering the field of promotive and educational work is one of the evidences of the enlarging interest in forestry. American Forest Week received the active support of 89 distinct organizations last spring,

many, if not most, of which are of great influence and of national scope. Among the new organizations created, either wholly or partly, in the desire to promote wiser and wider use of our forest resources, the American Reforestation Association, the Izaak Walton League, and a number of new State forestry associations serve as examples.

Yet there is still uncertainty and confusion as to the specific things to be done. In considerable portions of the country the public mind, though earnest and receptive, is not properly focused. There is need for more and better information to supply individuals, and for enlarged means of bringing this information within their reach. Still more is there need for aiding the collective grope toward forestry by directing public support to definite, sound, and adequate programs and by diffusing the knowledge essential to intelligent public action. In particular, the situation calls for local programs under local leadership. Some of these are indicated on page 6.

THE CHANGING ATTITUDE OF FOREST INDUSTRIES

Evidence that the possibility of growing successive crops of timber on private land as a business has aroused the interest and is receiving the attention of the forest industries throughout the country is abundant and convincing. One has only to read the trade journals, to attend the conventions of lumbermen, pulp manufacturers, and naval stores producers, or to examine the correspondence of State and Federal forestry agencies to see the change in the attitude of large landowners toward forestry. There is no doubt that forestry as a public movement is being converted into forestry as an industrial practice.

This interest in the management of land for continued production of timber is not confined to one region of the United States, nor to any one group of forest industries. It is being brought about by an appreciation of the economic changes that follow the depletion of virgin timber and the steady westward movement of the center of lumber production. For many years in the Northeast second-growth timber has found a ready market. Here stumpage rates are now high enough to make clear the possibility of growing successive crops of timber with profit; and through this region for-

estry is destined soon to be on an established basis. In the State of Maine alone over 9,000,000 acres of forest land, largely owned by pulp producers, are being handled under some form of forest management.

In the southern pine region there is in evidence a remarkable growth of interest in the possibilities of timber growing on cut-over lands. No fewer than 18 lumber companies, including several of the largest owners of land in the South, have definitely committed themselves to the management of their properties for continuing crops of timber. Because of the interest of its members in the practice of forestry on their lands, the largest lumbermen's trade association in the South has taken an advanced stand in promoting reforestation. In the same region the growing scarcity of timber for turpentine has aroused apprehension as to the future of the naval stores industry and created interest in putting this industry on a stable basis through the growth of successive crops of timber. As was mentioned in last year's report, this industry sent abroad in 1924 a commission of prominent producers and factors to study the methods used in the Landes region, where the French have so successfully perpetuated their naval stores resource. Partly as a result of this commission there is being pushed vigorously the organization of an institute to be supported by the industry, one of whose main objects will be to work out and demonstrate forestry practices and methods of timberland management that will secure continuous production.

On the Pacific coast, where the local effects of timber depletion are further in the future than elsewhere in the country, it would be natural to find little or no active interest in the growing of timber crops on cut-over lands. Yet in the Pacific Northwest the largest private owner of virgin timber in the United States has recently employed a trained forester and organized a department to discover without delay what measures should be taken to perpetuate timber growing on its forest lands. Another large lumber manufacturing and timber owning company, recently removed from the South, is making a careful study of its lands with a view to working out a system of management for sustained yield. Industrial research in the condition of logged-off land and possibilities of reforestation is being conducted on a large scale by associated

timberland owners. In the redwood region of California operators controlling two-thirds of the lumber cut are either actually reforesting their lands or investigating its feasibility. Several nurseries are maintained by redwood lumber companies. During the past two winters between 3,000 and 4,000 acres of cut-over land was planted, and the program calls for a rate of 10,000 acres per year five years hence. By the winter of 1930 the annual planting area will equal that cut over annually by the operators concerned, with a margin to restock gradually the lands cut over in the past.

Out of 15 leading lumber manufacturing concerns in California 5 have trained foresters in responsible positions, and all of the leading lumbermen's associations on the Pacific coast have foresters as their executive officers.

It is not to be expected that essentially manufacturing industries, no matter how keen their appreciation of the possibilities for continuous production from their lands, may be transformed overnight into organizations for long-time land management. This can only come about through a slow process; many long-established traditions and viewpoints, forms of organization and investment, methods of operation and financing must be changed. These factors will yield but slowly to the pressure of higher timber values and other new conditions. But it can be confidently said that progress in this evolution has started. The rapidity and extent of the progress will depend in great part upon the reduction of fire risk and upon a solution of the tax problem.

Another obstacle of no mean importance is the lack of authentic information on timber supply and consumption, timber values, transportation conditions, costs of timber growing, the stumpage yields obtainable, and other economic and silvicultural factors. The demand for such information can not now be satisfactorily answered and will continue to grow. The Forest Service believes in working with the forest industries in all helpful forms of cooperation which will enable or assist them to progress through internal evolution guided by enlightened self-interest toward their new function of land management for the continuous production of timber crops. It has done much in the past to arouse interest in the possibility of growing timber crops. Now it can

render a great service to forestry if it can provide current and authoritative information concerning timber growing, timber management, timber utilization, and forest economies. This information can only be obtained by extended and sustained research.

BETTER UTILIZATION OF TIMBER

The enormous quantities of wood now unutilized in the processes of logging, manufacture, refabrication, and final consumption constitute a large and partially preventable drain on our timber supply. Hence economy in the conversion and ultimate use of timber should be recognized as a phase of forest conservation on all fours with timber growing. A significant and far-reaching movement has recently developed in this field. A national conference on timber utilization was called by the Secretary of Agriculture in November, 1924, and attended by 400 representatives of timber-producing and consuming interests. It formulated a program for joint industrial attack on timber waste, particularly as related to trade and industrial practices; and following this, a national committee on wood utilization was created, under the leadership of the Department of Commerce and with active participation of the Forest Service. Following the lines successfully carried out in the standardization of lumber grades and specifications, this committee will seek to deal with other problems of timber waste where like industrial savings or benefits can be secured through intelligently directed joint action by the business groups immediately concerned.

MUNICIPAL FORESTS

That municipal forests are rapidly increasing is another evidence of the spread of forestry. Fitchburg, Mass., apparently the first community to establish such a forest under a State law, started in 1914 with 109 acres. To-day there are at least 250 town forests with an area of more than 500,000 acres. Though most of them are in Massachusetts, New York, Pennsylvania, Connecticut, New Hampshire, and Vermont, 26 States are represented. Troy and Rochester, N. Y., New York City, Chicago, Seattle, Newark, N. J., and Asheville, N. C., own forest areas exceeding in each case 10,000 acres.

Often the prime purpose of the municipal forest has been the protection and conservation of municipal

water supplies. Land surrounding reservoirs, lakes, or streams has been purchased and parts lacking tree growth are being planted. Fully 40,000,000 forest trees have already been thus planted. Municipal forests also often provide local recreation areas. A few have begun to return revenue. New Bedford, Mass., with a forest of 1,400 acres, reported returns from the sale of cut timber in 1921 of \$11,015 and from the sale or lease of other resources of \$4,738; Keane, N. H., reported returns of \$15,000 in the same year; Hartford, Conn., of \$7,000; and Newark, N. J., of \$3,175. A survey of the recently established municipal forest of Albany, N. Y., disclosed salable wood products having a value of at least \$40,000.

There is no reason why municipal forests in the United States should not annually or periodically be a source of income to their owners, as are such forests in Europe, aside from usually affording wholesome forms of outdoor recreation. In many places forest land bearing young growth can be bought almost within a stone's throw of American municipalities at prices much lower than European cities have paid for bare land. With the increasing value of forest products, greater knowledge concerning our forest trees, more adequate forest fire protection, and cheap forest land, municipal forests should be of growing importance as local sources of timber, areas for the demonstration of correct forestry practices, and producers of revenue to their fortunate owners. They may also serve as security behind bond issues or loans, as is the case abroad. In 1924 the city of Ebersbach, Germany, pledged as security its 7,400-acre city forest in arranging with an English banking house for a substantial loan.

PROGRESS IN STATE FORESTRY LEGISLATION

Much progress was made in the State legislative sessions of 1925 in the enactment of forestry laws. Outstanding are the laws enacted by Georgia, Idaho, Missouri, and Oklahoma for the establishment of State forestry departments and the appointment of State foresters. Changes in the character of the State forestry organizations were made by Minnesota and North Carolina. The former abolished the State forestry board, creating in its place a department of conservation headed by three commissioners administering respectively forestry and fire prevention, game and

fish, and lands and timber. The commissioner of forestry and fire prevention supersedes the State forester and is the chairman of the new department. North Carolina elevated its geological and economic survey, which has heretofore had control over the forestry work of the State, to a department of conservation and development. Illinois created a department of conservation with forestry included in its field of duties. Delaware created an investigative commission to study forestry problems and recommend a program to the next legislature.

Chief among the new fire-protection measures are the Idaho and West Virginia laws for compulsory patrol of forest lands and the Idaho law to regulate slash disposal. California made it a misdemeanor to throw away burning tobacco or any other flaming substance which may cause a fire; Massachusetts provided for the closing of fishing, hunting, and trapping seasons during periods of forest fire danger; Michigan prohibited brush burning without permits; New Hampshire required the registration of portable sawmills, their use of spark arresters, and the disposal of slash around their locations, and provided for closing the woods to hunters, trappers, fishermen, and others during periods of protracted drought; and Pennsylvania authorized closing the hunting and fishing seasons and forbade the smoking of tobacco and the building of fires in the woods during dangerous fire periods.

Laws having in view more equitable taxation of forest lands were passed by several of the States. Michigan provided for a modified yield tax on privately owned lands which are classified as commercial forest reserves; New Hampshire, for partial relief from taxation for a period of 30 years of lands not exceeding \$25 in value when planted to forest trees; and Ohio, in the usual type of yield tax law, for the classification of forest lands which the owner shall declare to be devoted exclusively to forestry. Porto Rico provided for a reduction in taxes on lands planted to forest trees. The Illinois legislature initiated a constitutional amendment to permit land devoted to reforestation to be separately classified.

Illinois also authorized the creation of State forests through purchase and the establishment of forest nurseries, appropriating for these combined purposes \$100,000. For the same purposes Indiana established a special

state-wide tax on all property, estimated to yield approximately \$25,000 annually, for the purchase and maintenance of State forests and the growing of forest planting stock. The most forward step in this direction was taken by Pennsylvania, which enacted a law enabling that State to issue bonds if a pending amendment to the constitution which authorizes a bond issue of \$25,000,000 for acquiring lands for State forests is approved by the electorate. Porto Rico provided for an issue of \$50,000 in bonds for the purchase, protection, and development of insular forests.

Enabling acts to permit the acquisition of lands for national forests were passed by Oklahoma, Vermont, and Wisconsin, the latter placing a limit on such acquisition of 100,000 acres.

Important forestry measures that failed were those in Arkansas, Florida, and South Carolina to establish State forestry departments; in Montana, to elevate the present forestry department from a division in the land department to a separate State board of forestry; in Massachusetts, to increase the effectiveness of the local town fire-warden system by bringing it under the direction of the State protective organization; in Oregon, to allow the State board of forestry to establish a value on denuded forest land for taxation purposes; and in Texas, a resolution to amend the constitution so as to empower the legislature to enact just laws for the taxation of lands set aside for growing timber.

The forestry laws enacted during the 1925 sessions of the State legislatures are proof that the States are steadily developing and completing their forestry policies. It is all a part of the outward spread of forestry in the United States. State forestry laws have a close relationship to the cooperative Federal forestry policy established by the Clarke-McNary law and form an essential part of the national program. Unfortunately, four of the largest timbered States—South Carolina, Florida, Mississippi, and Arkansas—have yet to adopt a forest policy.

An essential matter everywhere is the development of State forestry departments along lines that will assure high standards of integrity, professional and administrative competence, and devotion to the public welfare. These can not be expected and in the long run can not be had if the work is not supported and watched by a vigilant public opinion, and organized and administered on sound principles.

While no mere mechanism is sufficient to produce good government automatically, good organization is as important to success in public business as in private; and efficiency equally requires singleness of purpose. Personnel must be chosen for merit, and subserviency to special interests of whatever character must be effectively barred. A State forestry department should therefore be so organized as to protect it against control for other purposes than the best service of the public interests. The art of government is still undergoing development, largely by the method of trial and error; and there is still plenty of room for progress by the States in putting their forestry organizations on the best basis. The rate of progress will depend on the clearness with which the public grasps the real nature of its forest problem and the importance of meeting it—in other words, public education is here as everywhere else a pressing need.

NATIONAL AID IN THE ADVANCEMENT OF FORESTRY

The Clarke-McNary law, enacted June 7, 1924, laid down a policy of national aid to States in the advancement of forestry along broader lines than those previously pursued by the Forest Service under earlier acts, and provided a legislative basis for appropriations in furtherance of this policy. The first appropriation will be available for the fiscal year 1926. A program was approved by the Secretary of Agriculture consisting of:

(1) Cooperative study of the protective requirements necessary to keep the forest lands in each State productive.

(2) Financial cooperation looking to the establishment and maintenance of State-wide protective systems on all classes of forest land needing protection, whether publicly or privately owned and whether timbered, cut-over, or burned.

(3) Cooperative study of forest taxation with a view to formulating recommendations that will better adjust tax laws to timber growing.

(4) Cooperative production of forest planting stock for distribution to encourage the growing of timber crops, windbreaks, and shelterbelts on farms.

(5) Cooperation with the State agricultural extension services and departments of forestry to make better known and bring into wider use good forestry practices by farmers.

THE WORK AHEAD

It seems probable that the general course of our progress in forestry for the next 5 or 10 years has been charted. Very much remains to be done, however, to get forestry into actual land usage and to speed up the growing of timber to the rate needed to offset our national consumption of wood. The most urgent steps called for to meet the responsibility and assume the share of the Nation in that program are:

(1) Appropriations under the Clarke-McNary law sufficient to make it fully effective; that is, to set in motion the greatest possible State and local effort for forest protection, forest planting, and timber-growing on farms.

(2) A settled fiscal policy for the purchase of national forests under the Weeks and Clarke-McNary Acts. Without this the extension of the national forests in the Eastern States in accordance with the policies approved by Congress can not be efficiently planned or economically conducted.

(3) Provision for planting the 2,000,000 acres of denuded lands in the national forests at a much more rapid rate than the present snail's pace of 10,000 to 12,000 acres annually. The Government should set a better example of forest restoration on its own property.

National progress in forestry depends to at least an equal degree upon State and local undertakings and upon private initiative. The largest opportunities in these fields are:

(1) Commercial timber growing, the possibilities of which merit the careful study of lumbermen, paper manufacturers, and others concerned with timber products or timber-producing land.

(2) Extension of municipal forests and community tree planting.

(3) Development of State programs covering forest protection, State forest ownership, equitable adjustment of forest taxes, aid in timber planting, surveys of local land conditions to determine where timber growing is needed, and educational work among landowners.

(4) Organized educational effort in support of the specific things to be carried through in each locality. Public education is the only effective means in the long run of changing the national attitude toward forest fires and furthering forest protection through well-drawn and well-enforced laws.

COOPERATION WITH THE STATES IN FORESTRY

The Clarke-McNary law opens a new era in cooperative work with the States. Its chief purpose is to encourage local forestry. By stimulating State and private fire control it aims at making the country safe for forest production to meet the enormous needs of our still expanding agricultural and industrial development. By authorizing cooperative study of forest taxation it aims at removing a second great obstacle to timber production, local in nature yet general in its results. By encouraging farm forestry through (1) State production and distribution of planting stock and (2) State provision for informing and aiding farmers in applying forestry in the management and utilization of their woodlands it aims at extending the practice of timber growing amongst the great body of our rural population. Thus it recognizes that progress in forestry necessitates inducing States, counties, towns, and individuals to do their share.

PROTECTION OF STATE AND PRIVATE FORESTS FROM FIRE

The beginning of cooperation under the Clarke-McNary law also marks the ending of cooperation under section 2 of the Weeks law. Since 1911 the States have been assisted under that law in protecting from fire private and State lands on forested watersheds of navigable streams. It has been a great stimulus and encouragement to the timbered States to adopt protective measures. During its operation the cooperating States rose from 11 to 29, the area protected was trebled, and the combined yearly expenditure by the Federal Government and States was multiplied by five. Forest fire protection by private owners, themselves the largest holders by far of the lands protected, increased still more.

The allotments to each State during the past year, including emergency allotments to those States which experienced unusually severe fire seasons, are shown in Table 1.

TABLE 1.—Cooperative expenditures in fire protection under the Weeks Act, fiscal year 1925

State	Federal	State	Total
Maine.....	\$19,875.00	\$172,254.59	\$192,129.59
New Hampshire.....	7,040.27	44,726.49	51,766.76
Vermont.....	4,200.00	6,582.02	10,782.02
Massachusetts.....	8,970.00	64,387.79	73,357.79
Rhode Island.....	625.00	5,507.03	6,132.03
Connecticut.....	3,687.12	31,397.83	35,084.95
New York.....	20,940.00	172,021.17	192,961.17
New Jersey.....	5,605.00	78,969.12	84,574.12
Pennsylvania.....	19,875.00	207,340.56	227,215.56
Maryland.....	3,850.00	13,150.56	17,000.56
Virginia.....	19,953.91	23,769.40	43,723.31
West Virginia.....	10,500.00	28,670.33	39,170.33
North Carolina.....	19,875.00	28,509.20	48,384.20
Tennessee.....	11,120.95	11,700.00	22,820.95
Kentucky.....	289.72	723.28	1,013.00
Alabama.....	10,721.88	16,150.00	26,871.88
Louisiana.....	20,050.00	43,185.00	63,235.00
Texas.....	17,997.60	17,997.60	35,995.20
Ohio.....	1,600.00	11,000.00	12,600.00
Michigan.....	23,935.00	342,258.33	366,193.33
Wisconsin.....	15,000.00	29,091.99	44,091.99
Minnesota.....	19,875.00	215,903.71	235,778.71
South Dakota.....	100.00	4,368.45	4,468.45
Montana.....	10,753.19	12,523.87	23,277.06
Idaho.....	20,874.66	71,368.80	92,243.46
California.....	22,425.00	72,454.00	94,879.00
Washington.....	20,490.00	60,049.43	80,539.43
Oregon.....	20,050.00	56,169.15	76,219.15
New Mexico.....	800.00	1,962.00	2,762.00
Administration and inspection.....	38,180.87	-----	38,180.87
Total.....	399,260.17	1,844,191.70	2,243,451.87
Unexpended balance.....	2,639.83	-----	-----
Appropriation.....	401,900.00	-----	-----

In spite of increased expenditures, alertness, and efficiency, reports indicated very large losses from forest fires during 1924. In round figures, 92,000 fires covered nearly 29,000,000 acres of Federal, State, and private lands and caused an immediate property loss to timber and improvements alone of \$38,000,000. More than 90

per cent of these fires were man caused. Incendiarism held first place, followed by brush burning, smokers, railroads, camp fires, lightning, lumbering, and miscellaneous causes.

The indicated number of fires in 1924, the damage caused, and the area burned in the several forest regions are shown in Table 2.

TABLE 2.—*Summary of forest-fire statistics, by groups of States, for the United States (exclusive of Alaska), 1924*

Group of States ¹	Number of fires		Damage		Area burned	
	Total	Per cent	Total	Per cent	Total acres	Per cent
United States (exclusive of Alaska).....	91,921	100.0	\$38,128,426	100.0	28,822,735	100.0
Northeastern.....	7,969	8.7	920,568	2.4	240,963	.8
Appalachian.....	3,778	4.1	680,005	1.8	282,594	1.0
Southeastern.....	39,496	43.0	17,790,347	46.7	19,046,238	66.1
East Mississippi.....	3,530	3.8	1,334,035	3.5	922,337	3.2
West Mississippi.....	21,815	23.7	11,648,362	30.6	5,985,154	20.8
Lake States.....	3,307	3.6	600,754	1.6	489,278	1.7
Rocky Mountain.....	4,133	4.5	637,699	1.6	210,245	.7
Pacific.....	7,893	8.6	4,516,656	11.8	1,645,926	5.7

¹ Northeastern group: New England States, New York, and New Jersey.

Appalachian group: Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.

Southeastern group: North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

East Mississippi group: Ohio, Indiana, Illinois, Kentucky, and Tennessee.

West Mississippi group: Missouri, Arkansas, Oklahoma, Louisiana, and Texas.

Lake States group: Michigan, Wisconsin, and Minnesota.

Rocky Mountain group: Montana, Idaho, Wyoming, South Dakota, Nebraska, Colorado, Arizona, New Mexico, Nevada, and Utah.

Pacific group: Washington, Oregon, and California.

Table 2 reflects, in the Pacific group, the serious situation which developed in California in the summer and fall of 1924, when 2,657 reported fires burned over an area of nearly 1,000,000 acres, with a money loss to timber and improvements alone of more than \$2,400,000. But the most significant showing in this table is the loss reported by the Southeastern and West Mississippi groups, which embrace the large and important timbered States in the southern pine region, including the Carolinas, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, and Missouri. In these two groups occurred two-thirds of all the forest fires in the United States, more than three-fourths of the damage, and 87 per cent of the area burned. The Gulf States especially suffered through an unusually long, dry period extending for six months from the first part of June. There is also reflected in the losses reported from these two groups a realization that ground fires, heretofore largely regarded with indifference, are to be recognized and reported as forest fires.

With cooperation in forest-fire protection on the new legislative basis under the Clarke-McNary law, an expansion of notable importance in several particulars will automatically take place. First and foremost, this law recognizes that the purpose of Federal cooperation with the States includes permanent and adequate protection not only of timbered but also of cut-over lands, with a view to the continuous production of timber crops. The Weeks law restriction of Federal cooperation to forested watersheds of navigable streams having been removed, cooperation may now be extended to all forest lands in State and private ownership and, through a recent amendment of the law, to watersheds from which water is obtained for domestic use or irrigation. Like the Weeks law, the Clarke-McNary law will not permit Federal expenditure to exceed that of the State in the same fiscal year, but it broadens the basis of cooperation. In fairness to private forest owners, and in order to encourage their active participation, it allows the State to include with its own expenditures those of

forest owners which are either required by State law or incurred in cooperation with the State's protective system and under State supervision. In every such case the protection must have reasonable assurance of permanency.

Responsibility for organizing, administering, and maintaining the cooperative protection systems rests wholly on the State. The Federal Government, however, reserves the right to inspect the work at any time, offer suggestions, make recommendations, and withdraw cooperation from a State that fails to maintain a standard of protection commensurate with resources available.

COOPERATIVE STUDY OF FOREST TAXATION

The growing of wood crops, from seedling to saw timber, may span a century. Taxing such crops annually on an ad valorem basis presents difficulties. Heavy taxes have often forced the owner of old-growth timber to cut his timber as rapidly as possible, and as the forest wealth has melted away the incessant need of public revenue has increased the tax burden on what was left. Denuded forest lands pay little revenue for the simple reason that they produce little or nothing to pay revenue from, and often revert—an unwelcome and worthless gift—to the State in default of taxes. This vicious race between forest destruction and mounting taxes has raised a fear that managed forests may be subjected to confiscatory taxation. Neither the Nation nor the local community can afford to drive forest capital from the soil. To meet this need the Clarke-McNary law has authorized a study of "the effects of tax laws, methods, and practices upon forest perpetuation."

The first step in forest tax reform must obviously be to find out how the present tax system is actually working. It is unwise to change forest taxation without knowing exactly how the change will affect not only the business policy of landowners but the local revenues. The Forest Service plans to learn on the ground how much taxes forest land of various kinds—virgin, second growth, cull, or denuded—is paying, how forest land compares in valuation and assessment with other property in the same region, what part of the valuation is for the land and what part for the timber, what other taxes are borne by forests (such as income taxes), what

proportion of county and State revenue comes from forests as compared with other kinds of property, and how extensive is the evil of relinquishing cut-over land to the State or to tax sale.

The second step is to learn how the present tax system affects reforestation. Study is needed of the policies of timberland owners in holding, selling, buying, or relinquishing forest lands; of the relation of taxation to the growing of successive timber crops; and of the relation of taxes to other costs of timber growing.

Any change in forest taxation must adapt itself to the constitutional, legislative, administrative, and traditional restrictions of a given region, and to public opinion. The tax investigation will give a means of studying these local limitations and permit programs of tax reform suited to them. At the start it will probably be confined to three of the main forest regions. Typical counties will be selected for investigation, and in time samples of taxation practices under many differing laws and customs will be obtained. With these basic facts, such practicable modifications of State tax laws as will be equitable to the timberland owner, promote reforestation, and safeguard local revenues can be suggested.

This investigation can not be carried on by the Federal Government alone. It is only by State action that the property tax can be modified, and the States and local communities should participate in the study. The Forest Service will seek the help of State tax commissions, forestry organizations, local county and township officials, economists and taxation specialists, lumber associations, and forest industries. Though considerable thought has been given in the past to forest taxation, this is the first time that a comprehensive study of the subject has been undertaken with the certainty of being carried through. The work will begin about November 1 and will be in charge of Fred R. Fairchild, an authority on taxation and chairman of the department of economics at Yale University.

COOPERATION WITH THE STATES IN TREE PLANTING

Several million acres of farm land that at present produces little or nothing of value could produce valuable timber if planted to trees. In addition, there are farming sections where the planting of trees in windbreaks,

even on good agricultural soils, will afford much needed protection against the winds to crops and buildings and enhance the value of farm property. The present rate of planting these farm lands is about 12,000 to 15,000 acres yearly. At this rate the job would not be completed for 600 or 700 years. Farm owners need cheap planting stock. Some 19 States have recognized this need and maintain forest-tree nurseries that distribute planting stock to citizens. A few have been able consistently to increase the number of trees produced, yet have been unable to supply the public demand. New York and Pennsylvania lead in this respect.

New York maintains the largest forest tree nursery in the United States, will have 10,000,000 trees available for distribution during 1925, and plans to increase this annual output to 35,000,000 or 40,000,000 trees by 1927. This is nearly four times the present output and is made possible by an appropriation of \$120,000 for reforestation by the 1925 legislature. Pennsylvania produced 9,100,000 trees in its nurseries during 1924, and the demand for them is increasing so rapidly that it is expected to be fully 20,000,000 yearly by 1928. To meet it Pennsylvania plans an increase of its nurseries to a total area of 200 acres.

Large nurseries means tree production at low cost. In the Northeastern States forest planting will go ahead just as rapidly as the States supply the trees. This activity is gaining momentum in other regions also. Ohio is developing its nurseries to produce yearly about four times their present output. Some States, however, are hindered by inadequate funds and others are not authorized by legislation to grow and distribute forest trees. Cheap trees are either not available at all from commercial nurseries or are available only in small numbers. In States maintaining their own nurseries distribution by the State has had such an educational value that it has increased the sale of shade and ornamental trees, the type ordinarily handled by commercial nurseries.

Section 4 of the Clarke-McNary law is a recognition by Congress of the farm planting problem and of the desirability of joint State and Federal effort to solve it by the most practical means. This seems to be through the establishment of nurseries in States not maintaining them at present, the enlargement of those already estab-

lished, and the employment of the Federal fund when desirable in large-scale collections of forest tree seeds. Twenty-five States have applied for cooperation or have indicated that they wish to apply. Several of these have not previously pushed forest planting on farms because they were without sufficient funds. An allotment of \$2,000 of Federal funds annually to each State will provide the needed means to carry the work forward until State funds are supplied in adequate amounts. State funds budgeted for supplying forest planting stock to farmers in the fiscal year 1925 amounted in all to \$250,000.

COOPERATION WITH THE STATES IN FORESTRY EXTENSION

About one-third of the remaining forest land is farm woodland. Such lands comprise more than 150,000,000 acres, principally east of the Mississippi River. For the most part they can be managed as a part of the farm under methods of intensive forestry. Some idea of their importance is given by the fact that during the last census year they yielded forest products to a value of \$394,321,828.

The land is comparatively productive, markets are usually close, and considerable labor can be devoted to the woods without loss to the regular farm work. With proper care the average productiveness of farm woodlands will increase. They will furnish a large part of the Nation's supply of forest products.

During the fiscal year 1925 forestry occupied a place in the agricultural extension program in nearly two-thirds of the States, and was definitely organized as an extension project, with a forester in charge, in Georgia, Iowa, Maine, Maryland, Michigan, New York, North Carolina, Pennsylvania, South Carolina, West Virginia, and Wisconsin. Records in the Office of Cooperative Extension Work of the Department of Agriculture show that the allotments for forestry extension totaled \$35,766.

The beginning of the fiscal year 1926 made available \$50,000 to carry out section 5 of the Clarke-McNary Act. This section directed the Secretary of Agriculture to cooperate "with appropriate officials of the various States, or in his discretion with other suitable agencies, to assist the owners of farms in establishing, improving, and renewing wood lots, shelter belts, windbreaks, and other valuable forest growth, and in growing and renewing

useful timber crops"; and the State or other cooperative agency must expend during each fiscal year an amount at least equal to the Federal funds employed. Under date of May 25, 1925, the Secretary of Agriculture designated the extension service of the department as the agency to administer this appropriation and the work conducted under it. The Forest Service will cooperate in the program, which also seeks the cooperation of the State extension services and forestry departments in carrying on the forestry extension activities in the participating States.

EXPENDITURES AND RECEIPTS

In dealing with income and outgo the Annual Report of the Forester broadly corresponds to the annual report of a company to its stockholders. But great differences are necessary. In a private enterprise the crucial test of good management is ordinarily the balance sheet. National forest administration is a business undertaking in many ways; but its primary object is public benefits, not Treasury returns. To make an accountant's statement of assets and liabilities and of current capital investments as distinct from operating expenses would tell only part of the story, even if it could satisfactorily be done. While the Forest Service recognizes and accepts its financial accountability and enforces it through cost-keeping and the weighing of results against expenditures, in the nature of the case it can present no statement of receipts and expenditures closely resembling that of a private business enterprise. The following statement, adapted to the compass of an annual report, attempts no more than a summary of expenditures by major activities. They are compiled from detailed cost records which are available to anyone for study or analysis.

The disbursements of the Forest Service last year were made from 34 distinct appropriation items, each requiring to be accounted for separately, and having to be used as specifically directed by Congress. Some items may be used with large latitude; others may be used only for a single, limited purpose. Broadly speaking, the distribution of expenditures among the various items listed represents the judgment of Congress on the relative importance of the activities in which the service may engage. While the Forest Service presents, through the department and the Bureau of the

Budget and by hearings before the appropriations committees of Congress, what it conceives to be the relative needs for this, that, and the other expenditures, it does not finally determine how its funds shall be used.

The expenditures for all purposes during the fiscal year were as follows:

General administration-----	\$382, 027. 95
Protection of the national forests:	
Fire prevention and detection-----	1, 556, 866. 20
Fire suppression-----	2, 207, 533. 39
Protection against insects and tree diseases-----	52, 429. 71
Total-----	3, 816, 829. 30
Administration of current business on the national forests:	
Administration of timber use-----	895, 122. 51
Administration of grazing use-----	535, 944. 60
Fish and game protection-----	67, 621. 25
Administration of recreation and land use-----	100, 557. 19
Examination of power sites for Federal Power Commission-----	27, 955. 71
Total-----	1, 627, 201. 26
Surveys of lands and resources:	
General surveys and maps-----	116, 622. 80
Grazing reconnaissance-----	79, 672. 53
Timber surveys-----	206, 431. 22
Total-----	402, 726. 55
Land adjustment and extensions:	
Classification, settlement, and claims-----	92, 007. 45
Land exchanges-----	102, 326. 66
Acquisition under act of March 1, 1911, as amended-----	834, 373. 05
Total-----	1, 028, 707. 16
Nurseries and tree planting-----	162, 077. 78
Construction and maintenance of improvements:	
Construction of improvements other than roads, trails, and camp-ground improvements-----	550, 650. 94
Maintenance of improvements other than roads, trails, and camp-ground improvements-----	462, 209. 54
Camp-ground improvements-----	37, 631. 26
Total-----	1, 050, 500. 74
Research:	
Silvical investigations-----	288, 994. 32
Forest products investigations-----	647, 907. 31
Range investigations-----	70, 375. 04
Total-----	1, 007, 276. 67

Fire protection in cooperation with States under act of March 1, 1911----	\$399, 260. 17
Protection of Oregon and California grant lands----	81, 865. 58
Road and trail construction and maintenance: 10 per cent fund under act of March 4, 1913-----	518, 689. 28
Cooperative construction of roads and trails under act of July 11, 1916-----	1, 407, 394. 89
Federal forest road construction under act of February 28, 1919-----	82, 634. 91
Forest development roads and trails under act of November 9, 1921----	3, 057, 118. 96
Forest highways under act of November 9, 1921-----	5, 371, 185. 29
Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914-----	2, 009, 845. 64
Contributed from other appropriations-----	1, 353, 661. 62
Total-----	13, 800, 530. 59
Grand total-----	23, 759, 003. 75

Material differences appear in this statement from that presented for the preceding fiscal year. Aside from a general advance in salaries following the application of the reclassification act, certain items like equipment and supplies and miscellaneous investigations have been omitted and the corresponding expenditures distributed among the activities which they specifically support. Furthermore, this year's statement is different from that of last year in that all cooperative funds, as well as congressional appropriations, are included in the disbursements for the purposes for which such contributions were made. These total \$2,474,380.89. The major contribution of this nature, exceeding \$2,000,000, was for the construction of roads and trails as shown above. Other contributed funds were disbursed in the administration of timber sales, for the disposal of slashings on cut-over areas; in the protection of the national forests, for preventing and suppressing fires on intermingled private lands; and in research, particularly for investigations in forest products.

The statement, like that for last year, includes disbursements made by the Bureau of Public Roads in connection with the supervision and construction of national forest roads. In 1925 such disbursements amounted to \$8,991,428.83. The item under road and trail construction, "contributed from other appropriations," is made up partly of the time devoted to road and trail building or maintenance by forest

guards, rangers, and other officers who are carried under administrative appropriations, and more largely from a prorating to this class of work of a proportionate amount of the cost of the overhead represented by the supervisor and district offices.

A large increase in the expenditures for the suppression of forest fires will be noted. Aside from the inclusion of the cooperative funds disbursed for this purpose, the greater expenditure is due to the much more severe fire hazard encountered in the national forest regions during the past fiscal year.

The receipts from the national forests were as follows:

From the use of timber----	\$2, 940, 393. 30
From the use of forage----	1, 725, 376. 81
From miscellaneous uses, including the use of land, water-power sites, etc----	334, 367. 38
Total-----	5, 000, 137. 49

The total is less by \$251,765.62 than that for the previous year. Receipts from timber decreased \$96,002.45 and from grazing \$190,184.68. Receipts from miscellaneous uses rose \$34,421.51, mostly through increased recreational use under permit.

The entire decrease in timber receipts was due to a smaller cut in the Pacific Coast States, where unsatisfactory business conditions in the lumber industry and an extremely dangerous fire season combined to cause temporary suspensions of many logging operations. Elsewhere the timber business showed an increase. In the long run, the cut of national forest timber may be expected to advance at the rate of 8 to 10 per cent annually.

The decrease in grazing receipts was due largely to the waiver of grazing fees in the drought-stricken regions of the Southwest, under authority granted to the Secretary of Agriculture by Congress on February 28, 1925. It is estimated that the fees waived for the calendar year 1925 will amount to \$404,570, about one-half of which is chargeable to the fiscal year. A small decrease was also caused by a reduction in fees on certain ranges where the appraisal showed that the former charge was higher than the value of the forage justified. Delinquent grazing fees stood at \$83,739 on February 1, 1925, but have been somewhat reduced since that date. In the calendar year 1924, 146,107 fewer cattle and horses and 78,762 fewer sheep and goats used the forests than in the preceding year, but the numbers of livestock grazed in 1925 will

probably be close to the figures for 1923. These factors have partially offset the reduction in receipts resulting from the waiver of fees in the Southwest.

NATIONAL FOREST ADMINISTRATION

The Federal "forest reserves" were transferred to the Department of Agriculture February 2, 1905. They have, therefore, now been under administration as national forests for 20 years. Some outstanding facts call for comment.

Back of the change in name was an altered conception of what the forests should be. In the main their development has been a logical outcome of the viewpoint which laid stress on land management and sought usefulness of the resources in place of reservation for the future.

At the time of the transfer the forest boundaries included in all 63,027,884 acres, of which an unknown amount was non-Government owned. There was no accepted policy for extending them to include all public lands chiefly valuable for forest production, and no very clear idea in the public mind of what purposes other than timber preservation and water protection such Federal properties should subserve. Nor could it be truly said that the public looked upon Federal ownership and administration of the reserves already created as necessarily permanent. By many the lands and timber were regarded as temporarily in cold storage. Of land purchases to build up national forests in the East no beginning had been made.

The national forests are now a permanent public undertaking; their purposes are understood and indorsed; and their present gross area of 184,126,000 acres; of which 158,395,000 acres are Government-owned, includes probably 97 per cent of the public lands of the United States best suited to this form of use and not otherwise reserved. Congress has laid down a procedure for placing in the forests the rest of the suitable open public lands. The same law authorizes a large extension of policy in purchasing private forest lands, of which 2,584,000 acres have already been acquired or approved for purchase. The public enterprise in forestry is on a solid and secure basis, because after 20 years of trial and development its benefits have become indisputable.

The problems that have had to be solved in this period of growth have

been largely problems in land use of a fundamentally agricultural character. One of the largest tasks of the 20-year period has been that of land classification, primarily to segregate and open to agricultural development all areas chiefly valuable for agriculture. It has resulted in the segregation of approximately 23,000 homestead units. There could be no stability of the forest enterprise and no popular acceptance of its desirability until the agricultural land problem was settled.

The cut of timber has risen from 68,475,000 board feet in the year of the transfer to 1,038,000,000 board-feet in 1925, while receipts from timber have advanced from \$85,596 to \$2,940,436. Much more important, however, than the volume of cut or receipts is the development of a system of forest management around the production of timber as a crop. The main features of this system are: (1) The technical study and development of logging methods which insure reforestation; (2) the regulation of the rate of cutting on suitable areas so as to keep up a continuous yield of merchantable timber; and (3) the maintenance of stable forest industries and of permanent communities supported by them.

The management of the national forests during these 20 years has also pioneered in the regulation of stock grazing on public lands and the restoration of worn-out ranges to fair productiveness. A system of range administration has been developed under which more than 8,000,000 adult animals are now grazed on the national forests by 31,000 permittees. Its cardinal points are (1) building up the forage resources and the production of livestock through search for and the introduction of better methods of range management, and (2) stabilizing the use of the range, to the point that grazing permits are now issued for periods of 10 years. The system of range management thus far developed, while still imperfect, represents a striking contribution to the economic development of the Western States and the security of the livestock industry.

Along with these major forms of land use, an extensive organization for the protection of the national forests from fire has been created, with the physical improvements and equipment necessary for its efficient operation. And a Federal policy of road and trail construction has been evolved

under which a total of 10,000 miles of road have been constructed or improved, largely in cooperation with the Bureau of Public Roads, and 21,496 miles of trails have been built.

In 1905 the national forests were almost everywhere undeveloped wildernesses, unequipped with the primary necessities for their administration, protection, and use, unprovided with plans of management, unsupplied with a technical personnel capable of putting such plans into effect, unmapped, and with their resources and possibilities no more than guessed at; in short, unorganized, of slight usefulness, and of indefinite prospects. Many adjustments have had to be made in reaching the present stage of development and use. One underlying principle has been consistently followed—to bring about a coordinated and balanced use in order to obtain from each area the greatest aggregate of public benefits and the most valuable forms of service. This is exemplified in the place given to recreation in the national forests, the growth of which during the 20 years since 1905 is in itself a striking development.

The priorities followed in the use of funds and time to meet the growing and varied demands on the Forest Service illustrate the method of carrying out this general principle. Protection of the forests from fire and other destructive agencies holds first place, the production and use of timber second, and the production and use of forage third. Other activities, such as road and trail building, provision for recreation uses, and so on, where not essential for the protection or management of physical resources, are assigned a lower rating. In the instructions to forest officers establishing these priorities, however, latitude is necessarily given for meeting exceptional situations as reason and common sense may require.

EFFICIENCY IN THE EMPLOYMENT OF TIME AND MONEY

Four-fifths of last year's expenditures in the administration of the national forests went into salaries, wages, travel, and other items that form part of the cost of personal service. What the public gets for the money expended on the forests depends chiefly on the competence and morale of the personnel employed, the skill with which effort is directed toward the most important jobs, and the way in which the whole working

force is organized and led. In comparison with these things economy having in view solely reductions in the cost of travel, supplies, and material means efficiency at the spigot with inefficiency at the bung-hole.

The work of the field officer is of wide variety, with insufficient time for everything and without the possibility of close supervision. This accentuates the need for individual skill, initiative, resourcefulness, and drive. A forest ranger must do the best he can as a carpenter, mason, and road builder; he must have skill in the operation and repair of pump, boat, truck, and tractor engines, in the construction of ground and metallic circuit lines and the cure of the numerous troubles of telephone systems, and in the repair and fitting of wood and metal working tools. He must be a skilled woodsman, able to use and make simple surveys, estimate the volume and value of standing timber, locate the best routes for trails, transport supplies and materials by pack train, and care for himself and animals under all kinds of mountain conditions. To prevent fires due to carelessness he must on occasion appear before public audiences to explain the objects of national forest administration and to plead the importance of extreme care with fire in the woods. He must know fire law and what can and can not be done under each enactment, must understand how to gather legal evidence on which a conviction for crime can be secured, and must often act as prosecuting attorney in presenting cases before justices of the peace. He must be a master of fire-fighting strategy, resourceful and clear headed in the face of the most adverse and trying conditions that test physical and moral endurance, and be able to direct the organization and handling of a large fire-fighting force when a bad fire is on his hands—a task at which even experienced specialists seldom avoid errors.

Voluminous instructions on governmental business procedure, and special technical and administrative handbooks, dealing with the work of the Forest Service must be assimilated. Marking timber to be cut and enforcing timber-sale contracts in a way to make lumbering practicable while keeping the land productive involves nice decisions and informed judgment. Similar requirements must be met to insure the productivity of the forest ranges and find ways of induc-

ing stockmen to change time-honored but destructive practices. The management of timber and range requires special professional knowledge and skill, which the ranger may have; but if he lacks it he must do the best he can with such instruction as can be given him.

If there were time enough for the ranger to learn what he needs to know about the performance of all his jobs and to permit every task to be carried out fully, the problem would be relatively simple. This, however, is almost never true. Some things must be neglected. Day by day the ranger must decide which of the numerous things clamoring for his time shall be done next. Again, if timber and forage could be produced in a factory, it would not be necessary to depend so largely on the judgment, personal skill, and managing ability of the three thousand and odd district foresters, forest supervisors, district rangers, and the assistants, guards, and foremen who work under their direction. But 158,000,000 acres are under management throughout the country and present the most variable conditions of climate, soil, and human use. A decentralized form of organization with wide latitude in dealing with local conditions on the ground is essential.

The arts of forest and range management are still in a formative period and can not be embodied in strict rules of procedure or handled by precedent. The personal skill and initiative of local forest officers are constantly in demand, and Forest Service management must give these qualities all possible encouragement. A slight increase in average interest and enthusiasm may result in many thousand dollars' worth of added value in public property or service; a single betterment in the way responsibility is met may produce or save more than the cost of a season's food supplies.

How the problem is being met.—The main priorities and objectives, necessarily broad and simple as they are set up by the forester, become more detailed down the line of organization which spreads out to 817 ranger districts. The translation of priorities and objectives into work on the ground is done through plans. These are of three kinds—resource plans, work plans, and financial plans.

Resource plans outline the methods to be followed in managing timber, range, recreational opportunities, etc., by suitable area units. Work plans

lay out, in the form of job lists, the specific things to be done by a forest officer. They are made up after an annual review of all lines of work needing to be taken into account by each man in his use of time, and roughly assign the individual jobs to the period when each should be done. Additional jobs are inserted in the scheme as they turn up.

This system guards against giving either more or less time to an activity than is warranted by the priority accorded it. It requires only the most brief and simple records and is flexible enough to be readily modified as new demands are created by forest fires, unexpected sales of timber, or other unforeseeable calls on time. It is adapted to use by almost all classes of employees who have field work to do and insures that when a forest officer starts for anywhere he goes equipped with the instruments, tools, etc., needed for all the jobs awaiting him in that direction, and with a written list of everything that should be done on the trip. Thus he is able to proceed progressively from job to job, finishing each as he goes and using only a minimum of time for travel.

Financial planning begins early each winter. After considering with his ranger the work which should be provided for during the next fiscal year, the forest supervisor submits a proposed financial plan for his forest, showing each man to be employed, and, in the case of fire guards, the beginning and end of each term of employment. The amounts needed for travel, supplies, freight, etc., are shown with supporting data. These forest estimates are reviewed by the several district foresters, who usually find it necessary to disapprove most of the increases requested. Estimates are then submitted to the Forester, who reviews the financial problem requirements of the entire service and determines how the funds made available by Congress shall be allotted to different activities and administrative units. When the district foresters receive their allotments the estimates originally submitted by the forest supervisors are further revised and returned to them. These become the financial working plan which the forest supervisor is authorized and required to carry out during the year.

Forest fires, the greatest obstacle to the production of timber under American conditions, may be mentioned as requiring a separate form of plan, although the prevention and

suppression of fire enters largely into all resource, work, and financial plans. Planning for fire control requires much study, written records, maps, etc., but the most important step is listing in the personal job list of each officer the specific things he should do to prevent fires from being started and to have tools and men in readiness for the suppression of any fire that may occur.

The most perfect paper system of priorities, plans, and standard practice would be futile in work as complex as that on the national forests unless supplemented by frequent inspection and supervision on the ground. To obtain this the Forester personally spends each year 100 days or more in the eight national forest districts, gaining first-hand knowledge of the outstanding problems which have arisen, checking the accomplishments or failures of the district foresters, and advising them on questions of policy or practice. Supplementing this, the associate forester and from one to three trained men from each of the six functional divisions of the forester's staff spend from one to five months each year in inspection and supervision of the work on the ground. A similar system of inspection and supervision is maintained by the district foresters and their assistants. Such inspection not only serves as a follow-up on plans and instructions, it gives a reliable check on actual results in the woods and it brings to bear on the many unsolved administrative and technical problems the ability of the best-equipped specialists in each subject. The resulting personal contacts have also proved an effective means of developing the mutual respect, cooperation, and confidence, without which any organization is merely a steam boiler with no fire under it.

Standard practice in many forms has an important part in getting maximum returns for expenditures. Such standard practices are being developed as rapidly as experience warrants them. At the same time a wide range of physical resources and problems can not be effectively dealt with by machine methods or rules. The direction and control of field work must preserve a balance between the uniformity of method or system necessary to handle a large current volume of work efficiently and the encouragement and use of the technical capacities of individual men. In striking this right balance lies the key to prog-

ress in efficient and economical administration of the national forests.

To obtain an adequately qualified personnel is a matter partly of recruiting to get the right kind of material and partly of training to fit men to better performance and advancement. A recruiting system has been adopted which fills about half of the district ranger replacements with men professionally trained in forestry and range management. So far as possible these men are given practical experience beforehand through field employment during their college vacations. Technically trained recruits who are not equal to the responsibility of managing a ranger district when they receive their permanent appointments are put first at subordinate work. As they gain practical knowledge they will constitute a reservoir of well prepared all-around men ready for advancement. This recruiting plan has been made possible by the reclassification act, with its better adjustment of salaries to duties and the much greater flexibility which it permits in dealing with personnel.

One of the most serious problems now confronting the service is the difficulty of finding men adequately prepared for forest supervisorships and higher positions. The only solution is better training within the service. Training is now being given by inspectional contacts permitting demonstration of new or better ways of doing things, by assembling unseasoned fire guards before each fire season for instruction and drill in the work they will have to do, and by bringing together groups of employees, including men of the highest responsibility, to enable each to learn how to handle his job more effectively through demonstrations of the best practice and discussions of problems. Correspondence courses prepared by men who have intimate knowledge of service work have proved very useful in fields to which this form of training is adapted. In two national forest districts ranger training camps at which new rangers and some old ones are given systematic instruction are regularly held. These ranger training camps, with special emphasis on fire control, should be provided in every national forest district.

NATIONAL FOREST PROPERTIES

The net area of national forest land at the close of the fiscal year was 158,395,056 acres. The gross area,

which includes privately owned and State lands lying within the boundaries, was 184,125,912 acres. The net area increased during the year by 892,263 acres, of which 89,938 acres were purchased under the Weeks law. The gross increased 1,308,753 acres, of which, however, 3,626 acres represents recomputations of existing areas based on more exact surveys and projections.

Executive orders and proclamations and acts of Congress added 2,233,002 acres, including 298,870 acres of military reservation lands. The largest additions were to the Tongass and Chugach National Forests in Alaska, amounting to 1,104,169 acres and 254,057 acres, respectively, and to the Manzano National Forest, in New Mexico (312,250 acres). To increase the effectiveness of purchase work the Natural Bridge Forest, Va., was enlarged 110,286 acres.

Eliminations from the national forests aggregated 927,875 acres, of which 672,142 acres came from the Chugach National Forest, Alaska. Selections by the State of Washington in exchange for scattered State lands with-

drew 144,691 acres from the Chelan National Forest and 14,975 acres from the Rainier. From the Manzano National Forest 32,640 acres of land unsuited for forest administration was excluded. The other eliminations were minor boundary adjustments, largely to exclude alienated lands.

Section 9 of the Clarke-McNary law authorizes extending national forest administration to suitable lands within other Government reservations. On joint recommendation of the Departments of War and Agriculture 13 national forests embracing military reservations were created by Executive order, and five other reservations were added in whole or in part to adjoining national forests. Only three military areas believed suitable for national forests remain to be considered. That the areas may continue to be available for unhampered military use at the same time that the protection, development, and utilization of their natural resources goes forward, all rules, regulations, and plans of management for them as national forests will be jointly approved by the Secretaries of War and Agriculture.

TABLE 3.—National forests created on military reservations

National forest	State	Area national forest	Date of Executive order
		<i>Acres</i>	
Benning.....	Georgia.....	78,560	Oct. 3, 1924
McClellan.....	Alabama.....	15,350	Dec. 22, 1924
Jackson.....	South Carolina.....	20,225	Do. "
Lee.....	Virginia.....	7,177	Apr. 10, 1925
Eustis.....	do.....	4,220	Do. "
Humphreys.....	do.....	3,184	Do. "
Meade.....	Maryland.....	4,725	Do. "
Dix.....	New Jersey.....	6,785	Do. "
Tobyhanna.....	Pennsylvania.....	20,870	Do. "
Upton.....	New York.....	6,154	Do. "
Pine Plains.....	do.....	9,800	Do. "
Knox.....	Kentucky.....	22,660	June 5, 1925
Savanna.....	Illinois.....	10,710	Do. "
Total.....		210,420	

TABLE 4.—Military reservations added as districts to adjoining national forests

District	State	Area	Date of Ex- ecutive order
		<i>Acres</i>	
Brady.....	Michigan.....	2,680	June 5, 1925
Meade.....	South Dakota.....	5,548	Do. "
Pole Mountain.....	Wyoming.....	52,820	Do. "
Huachuca.....	Arizona.....	32,635	Do. "
Zuni.....	New Mexico.....	50,560	Apr. 20, 1925
Total.....		144,243	

Of the area shown above as added to adjoining forests a total of 55,639 acres was previously under national forest administration.

Land exchanges.—The year was noteworthy for its land exchange legislation. The act of March 3, 1925, authorized exchanges of lands purchased under the Weeks law. That of February 28, 1925, amended the general exchange act by authorizing reservations by either party of timber, minerals, or easements. The act of March 3, 1925, authorized the selection under the general exchange act of coal lands within the Custer National Forest, Mont., with a reservation to the United States of the coal and the right to mine and remove it. The provisions of the general exchange act were extended to certain described lands situated outside of but adjoining the following national forests: The Plumas, Eldorado, Stanislaus, Shasta, and Tahoe National Forests in California and Nevada, by the act of February 20, 1925; the Snoqualmie National Forest, Wash., by the act of February 28, 1925; the Mount Hood National Forest, Oreg., by another act of the same date; the Umatilla, Wallowa, and Whitman National Forests, Oreg., by the act of March 4, 1925; the Whitman National Forest, Oreg., also by another act of the same date. The act of January 12, 1925, authorized the acquisition through exchange of such parts of the Santa Barbara grant, in New Mexico, as were found to be chiefly valuable for national forest purposes, and the act of June 7, 1924, extended similar authority to the Las Trampas grant, N. Mex.

In effecting land exchanges the Forest Service will continue to pursue a conservative policy through which consolidation of the public properties will gradually and carefully be worked out on the bases of clearly determined public needs and conservative appraisals. The efforts of the year were directed mainly toward the preparation or refinement of land-exchange plans for each separate forest and toward more accurate determinations of correct bases of valuation and appraisal. Only exchanges clearly advantageous to the public will be made. Sixty-four exchanges were approved by the Secretary of Agriculture and transmitted to the Department of the Interior for action. They contemplate the conveyance to the United States of 64,836 acres of land chiefly valuable for timber production in exchange for 13,729

acres of national forest land, the stumpage standing upon approximately 2,454 acres, and an acreage of unreserved public domain equal in value to 11,500 acres offered in the one exchange which, under a special act of Congress, contemplates the selection of lands outside of a national forest. The pending exchanges, if all are consummated, will increase the net area of the national forests by 51,107 acres. The national forest lands to be surrendered are almost uniformly of low value for timber growth.

Satisfactory progress was made in effecting through exchange with the States the consolidation of scattered State lands in the national forests. The clear-listing to Washington of 159,665 acres in the Chelan and Rainier Forests leaves for final transfer only a minor part of the lands selected by that State. Final agreement was reached regarding the tract to be selected by Oregon and administered as a State forest, in lieu of all its scattered holdings. At the close of the year examinations looking to final exchanges with Montana and California were in progress, and preliminary consideration was being given to a final exchange with Colorado. The States will in each case acquire compact properties of value equal to their present holdings, susceptible of the most economical and effective administration and productive of maximum revenues, while the present scattered State lands will become parts of the national forests, with resultant lowering of protection costs and increased effectiveness of administration.

In the eastern national forests a total of 89,938.24 acres was passed into Government ownership by final perfection and transfer of title under the Weeks law, at an average cost of \$4.20 per acre, or a total of \$378,125.28. The appropriation of \$1,000,000 plus available balances permitted a materially enlarged purchase program, with the inclusion of some very desirable tracts in the White Mountains and in Georgia. The National Forest Reservation Commission authorized purchases totaling 247,067 acres, with a valuation of \$1,187,021.95, or \$4.80 per acre. This is 16 cents below the average for all lands approved up to this time, notwithstanding the inclusion of a considerable acreage of heavily timbered and relatively high-priced land.

The distribution, by States, of the lands fully acquired under the Weeks law is shown in Table 5.

TABLE 5.—*Acreage of timberland acquired in the fiscal year 1925 and total acquired to July 1, 1925, by States*

	Acquired 1925	Average price per acre 1925	Total acquired to July 1, 1925		Acquired 1925	Average price per acre 1925	Total acquired to July 1, 1925
	<i>Acres</i>		<i>Acres</i>		<i>Acres</i>		<i>Acres</i>
Alabama.....	4,500.01	\$4.81	87,304.87	South Carolina.....			19,522.54
Arkansas.....	2,006.11	2.92	59,337.41	Tennessee.....	17,432.28	\$7.44	267,938.59
Georgia.....	925.05	2.05	159,978.84	Virginia.....	9,430.83	3.90	502,016.03
Maine.....			32,255.98	West Virginia.....	20,843.78	3.29	219,124.48
New Hampshire.....	119.89	5.00	407,251.54	Total.....	89,938.24	4.20	2,212,285.25
North Carolina.....	3,903.92	5.51	354,289.15				
Pennsylvania.....	30,776.37	2.97	103,265.82				

The total cost of the lands fully acquired has been \$11,132,966.17, making the average cost per acre \$5.03.

No new purchase units were created, but the Cherokee unit in Tennessee was extended northward as far as the Little Tennessee River and southward into Georgia. These extensions amount to 245,694 acres.

The original plan of the National Forest Reservation Commission contemplated the purchase of 5,000,000 acres in the southern Appalachian region and 1,000,000 acres in the White Mountains. From time to time the original purchase areas have been enlarged and new purchase areas have been created in Alabama, Arkansas, and Pennsylvania. The present purchase areas contain approximately 9,122,299 acres. They include 921,699 acres reserved from the public domain, 11,369 acres transferred from the Treasury Department under a special act, and 2,584,076 acres acquired or in process of acquisition under the Weeks law. Of the remaining 5,605,155 acres, 1,021,401 acres are known to possess agricultural, mineral, or water-power values which preclude purchase. The net unacquired forest acreage in the existing purchase areas is, therefore, 4,583,754 acres. Some of it is held at such high prices by the owners that purchase can not be considered, and in many cases the owners give these lands such care and protection that there is no strong reason for public ownership.

It seems increasingly desirable to establish under the Weeks law additional purchase units, one or two in eastern Kentucky and one in the Ozark Mountains of Missouri. The resulting national forests not only would protect important watersheds and constitute valuable future sources of timber supply but also would serve as demonstration areas in regions where the progress in forestry up to the present time has been negligible. To complete the Weeks law forests, including

new units in Kentucky and Missouri, would require the purchase of an additional three and one-half to four million acres of land and an outlay, on the basis of average costs to date, of between \$20,000,000 and \$25,000,000. This expenditure would be inconsiderable when contrasted with the important public service the forests would render or the values which the areas will have when restored to maximum productivity through proper regeneration and management.

Studies prerequisite to the establishment of new purchase units under section 6 of the Clarke-McNary Act were continued. They confirm the belief that the Lakes States and the southern pine States constitute the most favorable and necessary fields for purchases under this act. The regeneration and maintenance of the forests in these regions, which constitute the main sources of future coniferous timber supply for the upper Mississippi Valley and Eastern States, is a problem of national importance. Through administration of typical areas as national forests correct principles and methods of forest management can be worked out for the guidance of other landowners at the same time that sources of future timber supply and the protection of watersheds are maintained.

The Lake States contain large areas of cut-over land that originally grew white and Norway pines. After removal of the virgin stand jack pine and scrub hardwoods succeeded. This inferior type in part persists, and in part has been practically destroyed by fire, so that artificial planting will be required to restore a forest cover. The lands are essential in the future forest economy of the Nation, but there is no promise that their restoration to timber production will ever be accomplished by private initiative. Their regeneration calls for public action. It is proposed that approximately two and one-half million acres

of land, largely of the type described, shall be acquired by the Federal Government and administered as national forests. The condition of this land and the considerable part which will require planting makes its present value relatively low. The average price should not exceed \$2.25 per acre, and the other costs of purchase should not run much above 25 cents per acre.

On these bases two and one-half million acres in the Lake States would cost about \$6,250,000, or for each \$1,000,000 expended the United States would acquire 400,000 acres. The recent enactment by the Wisconsin Legislature of a law authorizing the Federal Government to purchase and administer forest lands in that State paves the way for a complete Lake States program, since Michigan and Minnesota have similar laws of long standing.

In the southern pine region, soil values are superior and costs therefore higher. The natural reproduction of timber after cutting and the succeeding forest type are considerably better, and damage by fire is less complete; so that the appraisable resources are as a rule greater. Hence the average cost will probably be close to \$3 per acre. Examinations and appraisals will be more detailed and complex than in the Lake States, as will the title work and surveys, so that these costs of purchase will approximate 50 cents per acre, and two and one-half million acres of land will come to approximately \$8,750,000, or \$1,000,000 for approximately 285,000 acres of land.

Thus a total expenditure of \$40,000,000 would place under public supervision and management between 8,500,000 and 9,000,000 acres of forest lands which are indispensable future sources of timber supply and which bear a vital relationship to navigation and power development on some of the principal rivers of the United States. The inquiry of the Senate Select Committee established under authority of Senate Resolution 398, Sixty-seventh Congress, seems completely to establish that the management of certain types of forest lands must, in the nature of things, be a public rather than a private function, and that leadership in the development of sound principles of forest management and timber production through research and administration must also be a public rather than a private function. As the future needs of the Nation's citizens and industries for permanent sources of timber will inevitably be national and interstate in character, with many States lacking in home

sources of supply, a considerable proportion of the publicly owned land should be under Federal management.

It is hoped that Congress will establish a fiscal policy to govern the scale of forest purchases, which during the past eight years have been conducted under fluctuating appropriations. An economical organization and efficient conduct of the enterprise in its various stages of field examinations, appraisals, examinations of title, and surveys are practically impossible if it can not be sustained over a considerable period of years.

Special uses of land.—There was a normal increase in the number of special-use permits. The total number at the close of the year was 29,699, a gain of 1,050. Those issued without charge numbered 14,317. Paid permits increased by 682 and free permits by 368. As in earlier years, the principal uses were hotels, resorts, outdoor camps, summer residences, drift and division fences, pastures, reservoirs, and water conduits. These forms of use involve the occupancy of only a negligible percentage of the national forest area, but serve large numbers of people. During the fiscal year they returned a total revenue of \$229,235.72, which substantially exceeded the total cost of their supervision by the Forest Service.

Coordination of national forests and national parks.—Upon several areas of national forest land which have been suggested for inclusion within national parks, important material resources occur coexistent with the scenic and scientific features. This has resulted in doubt as to the form of management most in the public interest. The President's committee on outdoor recreation, on the suggestion of the national conference on outdoor recreation, has designated a committee to pass, in an advisory capacity, upon all proposals which contemplate transfers of land from the national forests to the national parks, or the reverse. This committee, which includes the heads of the Forest Service and the National Park Service, during the past summer has agreed upon desirable extensions of the Yellowstone National Park in Wyoming and of the Grand Canyon National Park in Arizona, together with certain adjustments in the park boundaries by topographic features designed to facilitate their administration. It has also indorsed the proposed enlargement of the Sequoia National Park in California previously agreed upon by the Forest Service and the National Park Service.

The movement to create national parks in the southern Appalachian region resulted in the selection as a park site of lands within the Smoky Mountains purchase unit, which had been established in 1911 under the provisions of the Weeks law. To facilitate the fruition of this movement the National Forest Reservation Commission, upon recommendation of the Forester, has abolished the Smoky Mountains purchase unit. The proposed Shenandoah National Park in Virginia involves no conflict with present or projected national forests.

NORTHERN PACIFIC LAND GRANT

The special joint committee of five Senators and five Representatives appointed under House Joint Resolution 183, Sixty-eighth Congress, to examine into the land claims of the Northern Pacific Railway Co., involving 3,000,000 acres within national forests, convened on March 18, 1925, and held hearings almost continuously until May 20, when it adjourned subject to the call of the chairman. It is expected that the joint committee will proceed with its investigation in the fall and will in due time report its findings to Congress.

In the initial stages of the investigation the railroad alleged an unsatis-

fied deficiency in its grant of approximately 3,900,000 acres. The position of the Forest Service has been that if the corrections, deductions, and adjustments required by the granting acts were made, and the mutual equities and obligations fully adjudicated, it would be found that the proposed deficiency selection of national forest lands within the indemnity limits would be unnecessary and should not be permitted. The Forest Service submitted to the joint committee an array of facts confirmatory of this position. Features of the grant were developed and agreed to by the Northern Pacific Railway Co., by which over 200,000 acres of land that otherwise would have been credited to the company have been saved to the United States. As yet the more important of the 22 major points raised by the Forest Service, involving lands of very much greater area and value, are undecided.

PROTECTION FROM FIRE

The number, size, and causes of the fires on the national forests in the calendar year 1924, as compared with those of the previous year and the average of the past five-year period, are shown in Table 6.

TABLE 6.—Comparison of fires on national forests, calendar years 1923, 1924, and five-year average for period 1920-1924

Classes and causes of fires	Number of fires			Percentages of total		
	1923	1924	Average, 1920-1924	1923	1924	Average, 1920-1924
Class of fire:						
Burns less than 0.25 acres.....	2,514	3,756	3,082	48.65	45.54	48.58
Burns between 0.25 and 10 acres.....	1,317	2,463	1,790	25.48	29.87	28.22
Burns 10 acres and over.....	1,337	2,028	1,472	25.87	24.59	23.20
Total.....	5,168	8,247	6,344	100.00	100.00	100.00
Causes of fires:						
Railroads.....	234	397	433	4.53	4.81	6.83
Lightning.....	2,052	3,421	2,466	39.71	41.48	38.87
Incendiarism.....	954	1,127	752	18.46	13.67	11.85
Brush burning.....	188	309	269	3.64	3.74	4.24
Lumbering.....	148	210	176	2.86	2.55	2.78
Camp fires.....	539	876	¹ 1,713	10.43	10.62	¹ 27.00
Smokers.....	858	1,551	-----	16.60	18.81	-----
Miscellaneous.....	195	356	535	3.77	4.32	8.43
Total.....	5,168	8,247	6,344	100.00	100.00	100.00

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost of fighting fires exclusive of time of forest officers
1923.....	<i>Acres</i> 263,848	\$180,544	\$276,598
1924.....	602,044	1,532,100	1,582,792
5-year average, 1920-1924.....	391,501	567,937	754,605

¹ Includes smokers' fires. Before 1922 camp fires and smokers' fires were classed together.

The fire season of 1924 was one of exceptional severity. The number of fires was greater by 30 per cent than the five-year average; the cost of fighting them, including guard and ranger labor, was greater by 105.6 per cent, and the damage on national forest lands was greater by 169.8 per cent. Compared with 1923, which was one of the most favorable years since the creation of the Forest Service, the figures contrast still more strikingly.

Light snowfall throughout the West during the winter of 1923-24, with a precipitation for the year from 30 to 50 per cent of normal, and almost complete absence of summer rainfall for long periods made an early and prolonged fire season and, combined with persistent high winds, severe lightning storms with little or no rain, and generally subnormal atmospheric humidity to make conditions extremely critical. In the Northwest, April and May were the driest ever recorded, and there were serious fires in early May. Even worse were conditions in California. Fires occurred as early as February and became more numerous and intense as the season advanced. At the height of the season fires starting during the middle of the day at times made runs of from 1,000 to 2,000 acres in an afternoon, necessitating the construction of from 5 to 10 miles of line to hold them the first night. The worst fires occurred in late August in southern California, where the drought was most pronounced and where the fire-fighting resources of the Forest Service were taxed to the utmost during the entire month of September.

In California alone there were 1,923 fires in 1924, an increase of 40.7 per cent over the five-year average. Their cost was considerably more than one-half of that of all fires on national forests during the year, and the damage ran slightly over \$1,000,000. Elsewhere the area burned was practically the same as the five-year average, but with a considerably greater loss and cost of control because of higher inflammability.

In southern California a board made up of representatives of four local organizations and several forest officers investigated the causes and the handling of the disastrous fires on the Angeles Forest to determine how far the protection system was adequate, to ascertain the responsibility for any lapses, and to make constructive recommendations concerning the future protection of this important forest, in-

cluding the cooperation of local agencies and its effective correlation with the work of the Forest Service. In an exhaustive report this board made numerous recommendations, which are being put into effect so far as possible. A board of forest officers studied the larger fires of northern California to devise improved organization and methods.

A detailed survey of fire hazards on or near the national forests was undertaken during the winter, and steps have been taken to eliminate or ameliorate dangerous situations. The forms of hazards found include sawmills without efficient spark arrestors, dangerous accumulations of slash along roads or on old cuttings, unsafe camp grounds, railroad rights of way with inflammable material, and the like. In many cases it has been difficult to eliminate these hazards, but good progress is being made through a progressive fire-prevention and preparedness campaign.

Smokers and campers combined are still responsible for approximately one-half of the man-caused fires. With continually increasing use of the forests, the problem of reducing the hazard from this source has become a tremendous task. It is requiring each year a better planned and more intensive country-wide educational campaign in fire prevention. In California and some portions of the Northwest it was necessary during the 1924 drought to impose emergency restrictions on recreational and other uses of some areas where local conditions presented especially high fire hazards. The building of camp fires was restricted to improved camp grounds made safe by the construction of fire places and fire lines, and smoking was prohibited on a number of areas. As in past years, camp-fire permits were required on many of the national forests.

As a result of a study of hazards created by lumbering operations, a new code of safety on national forest timber sales has been worked out and put into effect. The responsibility of timber purchasers for fire prevention and suppression will more definitely be set forth in future timber-sale contracts. Provision has been made for such things as storing fire tools and portable pumps on sale areas, maintaining patrols during hazardous periods, prohibiting smoking in the woods, and taking further precautions in the use of steam machinery. On the whole the timber operators are in agreement as to the necessity of these

restrictions and are cooperating fully in putting them into effect.

Excellent cooperation in fire protection continues to be given by residents on or near the forests, as well as by the general public. In view of the large number of fires caused through carelessness, however, there is need for better and more systematic organization of this cooperation in order that it may be more effective. This matter is being given the best thought of the service. A special effort is being made to reduce the number of man-caused fires through public education and by bringing home to the public its responsibility for prevention. Hand in hand with this campaign of education the Forest Service has waged one of strict law enforcement, with successful prosecution in a considerable proportion of the cases of man-caused fires.

The value of airplanes in fire control has been thoroughly demonstrated. When stationed at strategic points, not for regular patrol but for reconnaissance flights following lightning storms during periods of heavy smoke blankets, and in connection with the suppression of fires, they are of great help. Funds appropriated for cooperation with the War Department in airplane fire control during the fiscal year 1926 resulted in the assignment to this work on July 1 of 9 Army planes, stationed at strategic places. As a shortage of personnel in the Air Service of the Army made it impossible to obtain Army aviators, reserve officers were employed as pilots. The planes were used to make reconnaissance of large fires, to obtain confirmations and fuller information regarding fires reported, and to make flights for detailed observation of conditions after severe dry electrical storms, or when the air was too smoke filled for good detection from stationary lookouts. This cooperation should continue.

The 1925 fire season presented no serious early difficulties except in New Mexico and Arizona, where drought continued. In southern Arizona and New Mexico large fires were difficult to control during the latter part of May and early June. Severe electrical storms with little or no rain caused approximately three-quarters of the 739 fires which occurred in these two States to the end of July, when showers practically terminated the fire season.

In the Northwest severe electrical storms often accompanied by high

winds and low humidity started many fires in July, and by the middle of the month large fires were raging. Conditions were especially bad in northern Idaho, where a number of large fires very difficult to control occurred. In mid-August Montana and northern Idaho were having over 100 fires each day. Although most of them were held to small areas, the high inflammability of the country favored rapid spread and occasionally a fire attained large size in spite of every effort to bring it under control. In Washington and Oregon, though the situation was never as bad as in Idaho, August conditions were very severe, with large fires which severely taxed the organization. California had numerous fires in July. Otherwise the fire season in the West was about normal. In the East a drought of considerable proportion created exceptional August conditions on a number of the forests in the southern Appalachians, and some large fires occurred. Showers in early September relieved this situation.

In the Northwest relief began late in August, when scattered showers and cooler weather set in, and September was normal or below. By the end of the month the fire season was practically over throughout the West except in southern California, and even there the conditions were not serious. Up to September 10 there were in all 7,520 fires, which burned over 231,898 acres of national forest land. The unavoidable expenditures for suppression, \$913,667, exhausted the fire-fighting appropriation for the entire fiscal year 1926 and in addition made necessary the creation of a deficiency of approximately \$700,000.

PROTECTION FROM INSECTS

Bark beetles and other tree-killing insects are causes of loss in every body of mature softwood timber. Ordinarily only two or three trees per square mile are killed, or the insects may be restricted to trees injured by lightning or weakened by other causes. From time to time, however, the broods in some localities increase and an epidemic is started which may last for years and cause enormous damage.

These increases in numbers of beetles and in damage occur suddenly. A beetle attack is therefore comparable to a forest fire, except that the entire stand is seldom killed or the ground denuded. The loss in mer-

chantable timber if an infestation is not checked may with some kinds of trees be greater than if fire had run through the forest.

Constant watchfulness and prompt action are necessary if heavy loss from insects is to be prevented in old forests. It is impossible to foretell where an epidemic will break out or how great damage it will do if left unchecked. To combat an outbreak requires scientific knowledge of the life history of the particular insect involved and practical knowledge of how to get the necessary control work done economically.

The protection of the timber on the national forests from insect losses is conducted in cooperation with the Bureau of Entomology, which identifies the insects and recommends the methods to be followed in controlling them. The actual work of control, which in the case of bark-beetle attacks usually involves the falling and peeling of infested trees and sometimes the burning of the bark, is done by the Forest Service. Unfortunately funds are not available with which to fight all of the epidemics, and each year the work has had to be limited to a few places which appear to be the most important and on which the chances of success appear to be the best.

Last year the largest project undertaken was on the Kaibab National Forest, in Arizona. A species of bark beetle had killed millions of feet of old pine timber on this forest and on the Grand Canyon National Park adjoining it. In the spring of 1925 both the Forest Service and the National Park Service, acting under the advice of the Bureau of Entomology as to technique, continued vigorously their previous efforts to stamp out this infestation. The work appears to have been successful, and with a fortunate weakening in the broods of insects on part of the area which could not be covered by the control operations, further large expenditures on this project are not expected.

Three small infestations, two in Idaho and one in Montana, were completely treated, and a beginning was made in combating one of the largest and most enduring epidemics of tree-killing beetles known to American foresters and entomologists. This outbreak is in western Montana in the widely spread areas of mature lodgepole pine near the Continental Divide. The infestation has swept slowly south

and east, and is now on the headwaters of the Bitterroot River. It is approaching timber of greater accessibility and value than that in which it has been working for the last 10 years, and shows no signs of abatement from natural causes. Lack of funds prevented an earlier attack on this infestation, and heavy expenditures will now be necessary if it is to be stopped. If it is not stopped, the losses of merchantable timber will run into millions of dollars in value, and will decrease the timber supply of the region to a measurable extent.

The Forest Service should be empowered to deal with insect epidemics, following the advice of the Bureau of Entomology as to technical methods, as it does with fire. It should be authorized to incur expenditures necessary to meet the emergencies caused by insects when those emergencies arise. With its present limited authorization of expenditure for this purpose, effective work on epidemics while they are small can not be taken in all cases; consequently large losses result, and if control is undertaken later greater expenditures are necessary. The existing limitation on this phase of the protection of Government property should be removed, or the amount which may be spent greatly increased.

PROTECTION FROM TREE DISEASES

The eradication of wild currants and gooseberries on white pine areas in the White Mountain National Forest was continued during the year, in cooperation with the Bureau of Plant Industry. These shrubs are the alternate host of the white pine blister rust, and in their absence this disease can not become established. Cooperation with the same bureau also continued in devising economical ways of obtaining protection for the valuable white pine stands of the West, especially in northern Idaho. The rust is known to be spreading rapidly north of the Canadian line, and it seems inevitable that it will eventually become established in Idaho, Washington, and the other Western States in which valuable white pines grow. Local control through the eradication of currants and gooseberries will then be essential if white pines are to be grown and if valuable old timber of these species is to be saved.

The chestnut blight, unfortunately, does not require any other host than

the chestnut tree, and no method of controlling it has yet been devised. In the southern Appalachians it is spreading even more rapidly than it did in the Middle Atlantic States. Good progress was made during the year in disposing of the chestnut on the national forests in the Appalachian region before deterioration makes the wood unusable, and systematic efforts in this direction are to be continued.

The white pine blister rust and the chestnut blight are both undesirable importations from foreign countries. Our susceptible native trees have little natural resistance to them, and they are therefore especially dangerous. The native forest-tree diseases, especially the various rots, seldom threaten even the local extermination of any particular species, but do reduce the usable volume in forests of old timber. In selling timber from the national forests the cutting of infected trees is required in order to check the spread of these diseases and also to utilize any portions of the trees which are sound. A gradual improvement in the sanitary condition of the forest is thus obtained.

TIMBER

During the two decades of national forest administration completed in 1925 the cut of timber increased greatly. The cut in the second decade was more than double that of the first; and the \$20,249,229 received for timber in the years 1916 to 1925 was 230.4 per cent of the total for 1906 to 1915. The timber receipts of the last two years approached \$3,000,000 annually.

Timber growth has not been even. Periods of from one to three years during which there was slight gain or even a small decrease have been followed by large gains, as in the fiscal year 1924, when receipts from timber increased by \$310,730. In 1925 receipts decreased \$91,456. This was owing to the suspension of many lumbering operations on the Pacific coast during the summer of 1924. But the receipts for the last quarter of the fiscal year were the largest during any quarter in the administration of the forests.

An outstanding feature of the year was the increased manufacture and use of national forest timber in the mountain States, especially Colorado and Wyoming. Both the cut and the

receipts increased by from 20 to 30 per cent. The national forests of this region are the nearest and most logical source of timber supply for the people of the great valleys between the mountain ranges, and for much of the Great Plains. Industries and lumber users are more and more drawing upon the relatively near-by national forests. Few very large sales were made, but many new logging units were opened up by medium-sized operations using wagon or motor truck haul to the railroad or market instead of expensive logging railroads. This is a most desirable form of development for any region to which it is adapted, because the rate of cutting can be readily adjusted to the growth of timber on the unit and permanent operations are facilitated.

Applications for timber in new regions or watersheds have been gradually increasing, so that timber sales are more widely distributed among the various regions and national forests. In each of the eight national forest districts from one to six forests had timber receipts in excess of \$40,000 during 1925. This wider distribution of the business has made it necessary to put men trained in timber work on forests where the use of timber was previously insignificant. As the appropriations do not afford latitude for increasing the administrative force commensurately, the problem has to be met by filling vacancies as they occur with men who have been trained at forest schools. But it is impossible in many cases to add the administration of large timber sales to the already heavy work of a ranger district. With further increases in timber use a certainty, and with a constantly widening distribution of cuttings, a larger force of competent men to administer the sales will be imperative.

A wider distribution of the timber business is essential to carry out the principle of continuous production contemplated by the organic law. As lumber operations are ordinarily conducted on private lands, sawmills and other wood-using industries concentrate at favorable manufacturing points and follow new transportation facilities into forested regions. There is also a strong tendency for the individual plant to enlarge, requiring an increasing annual supply of logs. Hence the forest resources are rapidly and completely depleted from the areas tributary to these manufacturing cen-

ters, and a shifting and fresh location of the industries becomes necessary in from 10 to 30 years. It is this concentrated form of exploitation that in the past has rendered the lumber industry so unstable, frequently moving on and usually leaving dead or decadent communities behind.

Instead of yielding to the natural pressure to cut out the national forest timber available to established manufacturing centers, it is important that new locations be developed and operations widely distributed in order to maintain an undiminished yield of forest products. When national forest timber is offered for sale in large blocks a maximum rate of cutting is stipulated to prevent the exhaustion of stumpage available to an operation; and offerings are made only on a scale consistent with furnishing a continuous supply. The application of this principle may be illustrated by some of the larger sales made in 1925. On the Sitgreaves National Forest in Ari-

zona, 287,000,000 board feet, chiefly western yellow pine, was advertised for sale under a contract which limits the rate of cutting to an average of 30,000,000 feet annually. Approximately this cut can be obtained perpetually. Another sale was of 118,000,000 board feet of spruce, Douglas fir, cedar, and hemlock near the southwest corner of the Olympic National Forest in Washington, where again the timber tributary to the mill is ample to sustain it permanently.

A sale of 253,000,000 feet of timber on the Mount Hood National Forest in Oregon was advertised during the year and a bid for it received. Other large sales covered 130,000,000 feet on the Coconino National Forest in Arizona and 75,000,000 feet on the Stanislaus Forest in California to companies which have been buying national forest timber for many years.

Tables 7, 8, and 9 summarize the national forest timber business for the calendar year 1924:

TABLE 7.—Number of timber sales, classified according to amount of sale, calendar year 1924

State	\$100 or under			\$101 to \$500	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
	Commercial	Cost	Total					
Alabama.....	4		4					4
Alaska.....	343		343	6	6	7	2	364
Arizona.....	765	180	945	5	3	2	2	957
Arkansas.....	43	38	81			2	5	88
California.....	508	324	832	7	4	12	10	865
Colorado.....	564	206	770	17	3	10	12	812
Florida.....	83		83		1			84
Idaho.....	1,015	1,465	2,480	15	12	9	7	2,523
Michigan.....	17		17					17
Minnesota.....	32		32	3	4	1	2	42
Montana.....	596	993	1,589	20	7	11	3	1,630
Nevada.....	109	95	204	2				206
New Hampshire.....	137		137	1	2	2	2	144
New Mexico.....	728	290	1,018	3	1	5		1,027
North Carolina.....	247		247	6	4	4	2	253
Oregon.....	466	740	1,206	15	8	6	10	1,245
Pennsylvania.....	1		1				1	2
South Dakota.....	333	128	461	3	2	2	6	474
Tennessee.....	202	56	258			5	2	265
Utah.....	369	546	915	4		1	1	921
Virginia.....	393	20	413	3	2	8		426
Washington.....	267	153	420	12	1	11	3	447
West Virginia.....	12	1	13	1				14
Wyoming.....	291	263	554	3	1	3	1	562
Total, 1924.....	7,525	5,498	13,023	126	61	101	71	13,382
Total, 1923.....	7,279	4,990	12,269	125	86	143	97	12,720

TABLE 8.—Quantity and value of timber cut under sales, calendar year 1924

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	4,000		4,000			\$36
Alaska.....	52,539,000		52,539,000	91,792		91,792
Arizona.....	45,227,000	325,000	45,552,000	103,681	\$554	104,235
Arkansas.....	11,977,000	147,000	12,124,000	71,026	161	71,187
California.....	302,723,000	1,704,000	304,427,000	910,718	977	911,695
Colorado.....	40,901,000	762,000	41,663,000	111,983	812	112,795
Florida.....	1,428,000		1,428,000	6,201		6,201
Idaho.....	104,402,000	4,454,000	108,856,000	363,634	4,268	367,902
Michigan.....	45,000		45,000	80		80
Minnesota.....	4,926,000		4,926,000	17,979		17,979
Montana.....	69,192,000	3,211,000	72,403,000	151,195	3,319	154,514
Nevada.....	1,489,000	200,000	1,689,000	1,747	168	1,915
New Hampshire.....	6,398,000		6,398,000	38,517		38,517
New Mexico.....	22,989,000	703,000	23,692,000	38,945	650	39,595
North Carolina.....	10,336,000		10,336,000	34,997		34,997
Oregon.....	174,945,000	3,490,000	178,435,000	481,869	2,227	484,096
Pennsylvania.....	366,000		366,000	382		382
South Dakota.....	26,139,000	612,000	26,751,000	92,310	637	92,947
Tennessee.....	6,485,000	73,000	6,558,000	14,814	63	14,877
Utah.....	8,549,000	997,000	9,546,000	21,534	1,053	22,587
Virginia.....	7,028,000	54,000	7,082,000	26,642	69	26,711
Washington.....	109,926,000	468,000	110,394,000	196,083	266	196,349
West Virginia.....	530,000		530,000	1,049		1,049
Wyoming.....	66,965,000	569,000	67,534,000	158,609	562	159,171
Total, 1924.....	1,075,509,000	17,769,000	1,093,278,000	2,935,823	15,786	¹ 2,951,609
Total, 1923.....	1,037,229,000	17,806,000	1,055,035,000	2,736,152	15,607	² 2,751,759

¹ In addition, minor products not convertible into board feet were cut; value, \$14,074.² In addition, minor products not convertible into board feet were cut; value, \$11,317.

TABLE 9.—Quantity and value of timber sold, calendar year 1924

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	4,000		4,000	\$36		\$36
Alaska.....	73,763,000		73,763,000	136,446		136,446
Arizona.....	44,409,000	313,000	44,722,000	129,059	\$594	129,653
Arkansas.....	26,351,000	113,000	26,464,000	218,110	107	218,217
California.....	115,556,000	1,862,000	117,418,000	332,198	1,065	333,263
Colorado.....	139,224,000	761,000	139,985,000	392,721	784	393,505
Florida.....	1,263,000		1,263,000	5,400		5,400
Idaho.....	53,458,000	4,601,000	58,059,000	173,250	4,349	177,599
Michigan.....	195,000		195,000	230		230
Minnesota.....	7,188,000		7,188,000	31,293		31,293
Montana.....	52,689,000	3,619,000	56,308,000	112,571	4,006	116,577
Nevada.....	1,845,000	302,000	2,147,000	2,166	266	2,432
New Hampshire.....	6,243,000		6,243,000	26,164		26,164
New Mexico.....	11,483,000	755,000	12,238,000	25,699	644	26,343
North Carolina.....	7,509,000		7,509,000	33,314		33,314
Oregon.....	642,247,000	4,021,000	646,268,000	1,345,691	2,595	1,348,286
Pennsylvania.....	10,033,000		10,033,000	10,050		10,050
South Dakota.....	19,377,000	625,000	20,002,000	72,351	753	73,104
Tennessee.....	11,543,000	82,000	11,625,000	24,136	94	24,230
Utah.....	13,183,000	1,044,000	14,227,000	26,024	1,117	27,141
Virginia.....	8,405,000	68,000	8,473,000	23,212	83	23,295
Washington.....	57,596,000	522,000	58,118,000	101,302	311	101,613
West Virginia.....	516,000	1,000	517,000	765	1	766
Wyoming.....	9,430,000	1,055,000	10,485,000	20,852	926	21,778
Total, 1924.....	1,313,510,000	19,744,000	1,333,254,000	3,243,040	17,695	¹ 3,260,735
Total, 1923.....	3,128,859,000	17,877,000	3,146,736,000	9,016,938	16,356	² 9,033,294

¹ In addition, minor products not convertible into board feet were sold, value \$19,229.² In addition, minor products not convertible into board feet were sold, value \$17,282.

The use of timber from the national forests in Alaska continued to increase at a moderate rate during the past year. Most of the 52,500,000 board feet cut on those forests in 1924 was used locally for building, by the fishing industry for boxes or fish traps, and for mine timbers. Sawmills in Ketchikan, Wrangell, and Petersburg were rebuilt or enlarged in response to the better opportunities to market lumber locally and to ship the upper grades for distribution in general domestic and foreign markets.

During the year the results of a study of the water powers of southeastern Alaska made by the Forest Service in cooperation with the Federal Power Commission became available as a commission bulletin. Although it is certain that additional powers will be found as the region is more thoroughly explored and mapped, this report describes undeveloped water powers totaling 464,000 horsepower, mostly in units suitable for pulp and paper manufacture. This authoritative statement, supported by detailed data on stream flow and precipitation, places the available power of this region at a larger total than had been given in previous rough estimates by the Forest Service.

The rate of use of national forest timber in Alaska is controlled by broad economic and trade conditions. No paper mill has yet been built in the Territory, in spite of the abundance of cheaply loggable timber, the extremely favorable terms on which it may be obtained, and the availability of easily developed water power. The timber and water power make it certain that southeastern Alaska will ultimately become the seat of a large paper industry. Repeated examinations of specific water powers and definite bodies of timber by representatives of paper companies have confirmed the reports of Government officers concerning these resources. The large increase in paper production in Newfoundland and Canada, nearer the large markets of the eastern United States, has doubtless been an important factor in the common decision that the economic situation has not yet justified the establishment of mills in southeastern Alaska.

The offers of pulp timber on the national forests of Alaska under very favorable terms and conditions will remain open, and the water powers are available on application to the Federal Power Commission. The Forest Serv-

ice will do all in its power to encourage the establishment of a paper industry. Meanwhile the use of national forest timber for local purposes, with the export of the higher grades, continues to exceed the amount cut from the national forests of many States.

REFORESTATION

Protection from fire results in reforestation of denuded or burned lands wherever there is a near-by source of tree seeds. Enormous areas of old burns have reseeded naturally during the 20 years of fire protection on the national forests, and ample provision for seed trees is always made when timber is sold, so that cutting is followed by a new crop of timber. Where repeated fires have swept both old and young growth from large areas, however, the forest can be restored only by planting. As stated in last year's report, there are about 2,000,000 acres within the national forests that have been so badly burned that artificial reforestation is necessary, and other areas need to be planted as demonstrations of what can be done to make idle acres productive.

In the 20 years since the national forests were put under administration careful experiments have been made to determine the most practicable methods of artificially reforesting denuded lands in the various regions. Extensive tests were made of sowing tree seeds in various ways, compared with the planting of young trees which have been grown in nurseries for from one to four years. These tests demonstrated that the danger of entire loss is so great in direct seeding, that on all but a few exceptionally favorable sites on the national forests the planting of seedlings is cheaper per acre successfully reforested. Consequently most of the artificial reforestation during the last decade has been by planting. Experimental work in seeding has been continued, but attention has been given chiefly to the development of the best and cheapest ways of growing young trees in nurseries and to the most economical and successful methods of planting them in their permanent places on denuded areas. In the calendar year 1924, 12,640 acres were planted, rounding out a total of about 100,000 acres of successful plantations.

The work on the national forests is necessarily restricted to a few projects, in order to promote economy through low unit costs. Most projects

are located in regions where valuable timber can be grown rapidly and cheaply. The plantations on old burns in the Lake States, in northern Idaho, and in the Douglas fir belt of Oregon and Washington are examples. A few projects have been undertaken primarily to reforest watersheds where the prevention of erosion and the checking of run-off is important, as on the watersheds from which Colorado Springs obtains its municipal supply. And one large project, on the Nebraska National Forest, is both a demonstration of how the sand hills in a semiarid region may be made productive and a provision for a local supply of wood in a naturally treeless region.

The planting work is done chiefly under an appropriation made especially for it, but when their other duties permit, forest rangers or other administrative officers aid. During the past decade this special appropriation has been reduced by nearly \$40,000, although the cost of labor and materials has increased greatly. The present appropriation is barely enough to maintain seven nurseries with an annual output of 9,000,000 trees and to plant those trees in the field. Rigid economy, the immediate application of the results of investigations, and temporary details of men from other work to the greatest extent justifiable have already been practiced. The scale of the planting work on the projects now under way can not be expanded materially under the present appropriation.

The average annual nursery output of 9,000,000 trees, and the annual planting of from 10,000 to 13,000 acres on the national forests, which have over 2,000,000 acres needing planting, does not compare favorably with the work of State and private agencies in the same field. New York and Pennsylvania each maintain nurseries with larger total outputs than the nurseries of the Forest Service. Each has a definite program for doubling or trebling its present output. The area planted on State and private lands in the Lake States prior to 1923 (the latest figures available) was more than double the area of plantations on all national forests. The farmers and estate owners of the country are planting each year more than the United States does on its own lands which have been set aside for growing timber. Michigan planted on its State forests in 1924 over 6,500,000 trees on 5,691 acres, or nearly

half as much acreage and about two-thirds as many trees as were planted on all national forests.

In the Lake States there are over 50,000 acres of national forest land which must be planted. These forests are very accessible to the centers of population and timber consumption. Every effort has been made to increase the work in this region, and in 1924 over 4,000 acres were planted there. This work should be put on a stable basis of at least 6,000 acres annually, requiring from 12 to 15 years to get stands of valuable pines started on the burned, unproductive lands now within the forests. As the policy established by the Clarke-McNary law results in adding to the national forests of this region more denuded areas, the job will take longer.

Very little planting has as yet been done on the national forests in the Eastern States. Funds have not been available to do more than experiment in nursery practice and field planting on a small scale. About 50,000 acres of the lands purchased by the National Forest Reservation Commission should be planted to restore growth to land denuded by cutting and fire before it was acquired by the United States. A nursery capable of producing at least 2,000,000 trees annually should be established and about 2,500 acres planted each year. At this rate it would require 20 years to complete the work now on hand.

The present scale of work in the Idaho white-pine region in northern Idaho and western Montana and in the Douglas fir region of western Washington and Oregon is not only inadequate in view of the large areas of old burns that should be growing timber crops in those regions, but it is too small to enable full advantage to be taken of existing nursery equipment and organization. The reduction of appropriations during the past decade necessitated closing all but one nursery in each of these regions and operating those retained on too small a scale for the most economical production of trees. Instead of planting 2,000 to 3,500 acres annually in western Montana and northern Idaho, at least 5,000 acres of the highly productive land in that region should be reforested each year, and the work on the Pacific coast should be on about the same scale instead of the present one of 2,000 or 2,500 acres annually.

The program outlined could be carried out if the appropriation for the purpose were restored to its pre-war

amount. A 30 per cent increase in funds will result in a 50 per cent increase in acreage planted. Urgent reasons why the work should be put on at least this enlarged scale are:

(1) To bring into production nationally owned lands now idle.

(2) To help redeem the responsibility of the Federal Government for

assuring a supply of wood for the use and necessities of citizens.

(3) To set a proper example to private landowners, States, and municipalities, and to demonstrate what can be done with land which should be growing timber crops but is not.

Table 10 shows the area reforested during 1924.

TABLE 10.—*Planting and sowing on national forests by States, calendar year 1924*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan.....	3,171.50	-----	3,171.50	Oregon.....	47	-----	47
Idaho.....	3,155	10	3,165	North Carolina.....	12	-----	12
Washington.....	1,861	-----	1,861	Pennsylvania.....	11	-----	11
Colorado.....	1,758.01	-----	1,758.01	California.....	1	-----	1
Minnesota.....	1,243	-----	1,243	Wyoming.....	1	-----	1
Nebraska.....	1,045.73	-----	1,045.73				
Montana.....	251	-----	251	Total.....	12,640.24	10	12,650.24
West Virginia.....	83	-----	83				

RANGE

General conditions.—Except in Arizona, New Mexico, western Texas, and a small part of southern Utah the serious drought that in 1924 affected practically all the western ranges came to an end last winter. As a rule livestock went into the winter in fair shape; and rain and snowfall at the right time, with moderate temperatures, brought all classes of stock through with light losses and in excellent condition. A favorable spring and summer have followed, affording prospects seldom surpassed for sales of fat mutton and beef right from the ranges.

In the view of stockmen the grass season, outside of the Southwest, has been the best in 30 years. Rains have been fairly plentiful and timely, and ranges which in the fall of 1924 appeared seriously denuded have come back in an impressive manner. The calf crop has been fair, while the lambing was very satisfactory and the average of lambs saved unusually high. Wool and lamb prices though not quite equal to those of 1924 have been remunerative, and there has been a decided hardening in values of cattle. The livestock interests of the range States other than New Mexico, Arizona, and Texas will enter the winter of 1925-26 under excellent circumstances and with a fairly satisfactory showing for the year 1925.

Even in the Southwest livestock on the open ranges wintered very well, all things considered. In the Salt River Valley of Arizona, however, the desert ranges were absolutely bare, and sheep taken there to winter had to be fed in the local alfalfa fields at a high cost. Lack of feed and water along the driveways usually followed in the spring migrations northward from these ranges forced shipment of the greater part of the sheep to their summer ranges by rail. The summer range in Arizona, central and southern New Mexico, and western Texas was generally disappointing.

Remission of grazing fees.—On February 28, 1925, Congress authorized the Secretary of Agriculture to waive, in his discretion, the grazing fees in drought-stricken regions of the West. Reports from southern Utah, Arizona, and New Mexico showed that the drought was still severe on all but the three national forests in the northern part of the latter State; and the fees for the calendar year 1925 were therefore waived.

The amount remitted is estimated at \$404,570. In addition some fees were lowered because they were shown by the range appraisal to be above the fair value of the forage; this further reduced grazing receipts by approximately \$2,607.35.

Use of the range.—The grazing permits issued and the number of stock grazed during the calendar year 1924 are shown by Table 11.

TABLE 11.—*Grazing permits issued and number of stock grazed, calendar year 1924*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Number of stock grazed			Permits issued	Number of stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	5	66	11				
Alaska.....	1				1		
Arizona.....	1,327	276,910	2,610	306	99	255,162	7,330
Arkansas.....	42	1,361	3	81	1	8	15
California.....	2,405	187,689	6,177	275	397	463,701	4,992
Colorado.....	3,575	296,296	5,904	90	693	860,628	1,143
Florida.....	30	724		28	3	569	13
Idaho.....	3,481	150,932	9,669		862	1,424,508	63
Montana.....	2,275	141,886	10,476		388	570,218	50
Nebraska.....	33	12,040	417				
Nevada.....	439	69,174	2,315		103	293,832	
New Hampshire.....	23	169	10				
Montana.....	1,705	105,001	2,765	165	367	248,435	15,440
North Carolina.....	184	1,074	54	46	23	151	
Oklahoma.....	71	3,000	525				
Oregon.....	1,538	118,741	4,897	10	442	659,062	22
South Dakota.....	623	25,219	2,111		8	9,935	
Tennessee.....	28	217			2	44	
Utah.....	5,746	137,997	5,559	532	1,837	730,797	
Virginia.....	144	1,576			2	58	
Washington.....	656	24,358	1,210		132	169,567	
West Virginia.....	54	437	47	27	64	1,666	
Wyoming.....	901	109,220	3,424		270	612,967	
Total, 1924.....	25,286	1,664,087	58,184	1,560	5,694	6,301,308	29,068
Total, 1923.....	27,800	1,804,274	64,104	1,347	5,584	6,377,759	31,379

It will be noted that 146,107 fewer cattle and horses and 78,762 fewer sheep and goats were grazed in 1924 than in 1923, and that permits for cattle, horses, and swine decreased by 2,514, while sheep and goat permits increased by 110. This is attributed to liquidation in the cattle industry and to shifts of permittees from cattle and horses to sheep and goats.

The decrease in cattle occurred in all of the Western States, except Nevada, where the increase was only 1,841. In sheep and goats California, Colorado, Nevada, Oregon, South Dakota, Washington, and Wyoming showed increases, whereas Arizona, Idaho, Montana, New Mexico, and Utah showed decreases. Many sheep owners have been reducing their herds to the carrying capacity of their outside ranges, while some sheep reductions have been forced by adverse climatic and range conditions. The changes in numbers of permittees and stock were not as great as might have been expected considering the difficulties through which the industry has passed.

Over 9,000,000 acres of national forest range is badly infested with

gophers, prairie dogs, and ground squirrels. Approximately 390,000 acres were treated last year in co-operation with the Biological Survey, private land owners, and State and county authorities. About 75 per cent eradication was obtained. This work will be followed up as rapidly as funds permit.

Because of the foot-and-mouth infection the Stanislaus National Forest in California was closed to all live-stock grazing in August, 1924; and in May, 1925, the closure was extended to cover the entire calendar year 1925. Since the deer, which are fairly abundant, were found to be suffering from the disease the State authorized their killing. It was unavoidable for the protection of the wild life itself no less than of domestic stock. The work was done by expert hunters acting under the immediate direction of the department. Care was used to disturb the deer as little as possible and thus avoid the danger of their being driven out to infect adjoining foothill ranges. It is hoped that this work, together with closing the area to domestic livestock, will make it

possible to allow the stockmen to renew their use of the Stanislaus ranges in 1926.

Early in 1925 inspections by the Bureau of Animal Industry and officers of the sanitary board of Arizona showed that several cattle herds were infected with scabies. Some of the owners of these herds held permits on five different national forests in the State. A Federal quarantine was immediately established by the Bureau of Animal Industry and concurred in by the State authorities.

Livestock were not permitted to enter the national forests until they had complied fully with quarantine regulations. As the investigations progressed and additional infection was found in other localities of the State, a general dipping order was issued. The local forest officers cooperated fully in the enforcement of the regulations. The situation is believed to be entirely under control.

Livestock losses.—Table 12 shows the losses of permitted stock from various causes during the calendar year 1924.

TABLE 12.—*Livestock losses, 1924*

District	Disease		Poisonous plants		Predatory animals		Other		Total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	87	778	485	1,887	67	4,514	714	7,126	1,353	14,305
2.....	524	1,240	2,168	2,025	156	5,776	827	8,870	3,675	17,911
3.....	403	896	2,231	1,423	1,962	2,619	16,044	4,490	20,640	9,428
4.....	1,022	3,811	5,207	10,983	313	44,889	3,226	18,338	9,768	78,021
5.....	185	335	576	2,029	152	7,959	1,047	5,143	1,960	15,466
6.....	141	1,275	223	2,355	83	8,954	853	9,058	1,300	21,642
7.....	165	12	0	0	67	37	190	0	422	49
Total.....	2,527	8,347	10,890	20,702	2,800	74,748	22,901	53,025	39,118	156,822

In comparison with 1923 these figures show a large increase. In part this is because more complete data were obtained. Increased losses due to straying may be largely accounted for by insufficient labor employed to supervise the stock on the ranges. Losses from poisonous plants were no doubt increased somewhat by drought.

The above table indicates clearly the need to lessen losses. On many areas the Biological Survey has entirely eradicated predatory animals. This work not only brings a noticeable increase in calf crop and a decrease in losses of other domestic stock, especially during the early season of the year, when the animals are in poor condition, but also results in a decided increase in the number of fawns. From a business standpoint it would be well worth while if this work could be extended to all national forest ranges.

Stability of range use.—About 30 per cent of the cattle and sheep in the Western States use national forest ranges. Stable tenure in grazing these public lands is of the utmost consequence to the western livestock industry. On it depends more advantageous credit facilities, opportunity to improve the grade and quality

of herds, the extension of range improvements, and employment of the best methods of range management. In the long run also such stability will make for a larger and better supply of livestock products derived from this resource of the national forests.

At the same time overgrazing of the ranges should not be permitted, and their use must be harmonized with the conservation and development of other resources. Furthermore, a reasonable leeway should be provided to make range available for new settlers or small livestock producers who have a genuine need for it in developing and establishing their homes. The policy followed by the Forest Service has sought to stabilize grazing as far as compatible with these requirements. Reductions in the numbers of livestock have been made on ranges which showed evidence of overgrazing. Reductions or shifts in the pasturage of sheep and cattle have been made where injury was being done to young timber growth, to water sources, or to valuable herds of elk or deer. The older users of the range, particularly the larger users, have been reduced to a limited extent to make room for the flocks of homesteaders or small ranch owners, and since 1909 the total

number of small permits has increased about 25 per cent.

Notwithstanding these changes, the use of the national forest ranges by and large during the past 20 years has been more stable than that of any other grazing lands in the West, with the exception of a few large private ranches. A majority of the national forest permittees have regularly had their permits renewed from year to year for the full number of livestock they desired to graze. In particular localities reductions for range or timber protection or for the admission of new users have raised the question of instability and have challenged the soundness of the policy followed in providing pasturage for newcomers where the cutting of old users was involved.

In recognition of the importance of stable tenure in the use of grazing lands, the policy was begun in 1925 of issuing permits for periods of 10 years. Such permits were offered to all qualified applicants where safe carrying capacities have been arrived at and other local range conditions were sufficiently settled to warrant permits of this degree of permanency. During the fiscal year 32 per cent of the cattle and horse permits and 42 per cent of the sheep and goat permits were of this character. It is contemplated that a still larger application of the long-time permit will be accomplished in 1926.

The 10-year permit protects its holder from reductions, except in the event of damage to the range or other forest resources, during the first five years. At that time a cut of not more than one-tenth in the size of the herd may be made if necessary to provide more range for new settlers or small ranchmen. But no cut for this purpose can be enforced if equivalent reductions have been required for protection. Before the 10-year permits were issued all carrying capacities were rechecked and adjustments made for the protection of forest growth, watersheds, etc., in order that the use of the ranges during the next decade might be maintained on just as stable a basis as possible.

During the past year representatives of the livestock industry have asked for much more extreme measures of stability in the use of the national forests. These include a legal recognition of grazing rights, to be vested in the present occupants of the

range and to be terminable or reducible only by order of the Federal courts. They involve the practical abolishment of control or supervision of grazing by the Forest Service. And they would entrench the grazing right against reduction for the conservation of other resources or the benefit of other classes of national forest users, except when willful damage can be proven. In partial support of these demands the stockmen have pointed out that Congress has never defined the status of grazing on the national forests and that the present use of the ranges rests wholly upon administrative regulations which may be modified or revoked at the will of the Secretary of Agriculture.

The Forest Service must wholly dissent from giving the grazing of livestock any such preferred and impregnable status in the national forests. It would destroy the fundamental conception of conservation, which requires the perpetuation and development of all resources with such adjustments as are necessary to prevent injury and to obtain the greatest public returns from a given area. It would imperil the future productiveness of the ranges themselves. And it would be a denial of the principle of equality of opportunity in the use of public resources, in itself a vital feature of the conservation program.

At the same time the Forest Service believes fully in stabilizing the use of the national forest ranges as far as their own protection and the protection of other resources will permit and as far as the essential needs of new settlers and small flockmasters will justify. The service is prepared to make stability the key to grazing administration. While there has never been a statutory provision for grazing on national forests, the long-standing policy of the department recognizes the production and utilization of forage as one of their primary functions. The 10-year permits issued under authority of the Secretary of Agriculture have essentially the same standing as an obligation upon the Government and a form of security to the user as contracts for the sale of timber for which specific provision has been made by law.

It would doubtless be desirable to have the policy of the department as to the place of grazing in the national forests confirmed by legislation with specific authority to enter into con-

tracts for pasturing livestock during periods not exceeding 10 years, subject to such regulations as are necessary to protect the range and other resources of the national forests and to promote the public interest.

While the principle of curtailing grazing where necessary in the interest of range protection, of the preservation of young forest growth or the security of watersheds or the perpetuation of wild life must be retained, it is probable that, in the interest of stability, definite limits may be placed upon reductions for these purposes during the life of the term permits or contracts. And equally, while the principle of range adjustments to make room for the home settler or the small producer must be retained, its application may equitably be limited in accordance with local conditions in order to assure the stability needed by the established livestock industry. On a considerable number of national forests, in fact, sound economics and the dictates of good range management would appear to justify completely stabilizing range use for the next 10 years on the basis of the present herds and permittees. Elsewhere the opportunity must be retained to provide equitably for the genuine needs of land development and new settlement. It is obvious that, under a few general principles defined by legislation, the regulation and adjustment of range use under the widely varying conditions on the national forests must be left to administrative action.

Range management.—Improvement in the utilization of range is an essential feature of grazing administration on the national forests. On many grazing allotments conservative stocking, together with proper seasonal use, rotation grazing, the bedding-out system in handling sheep, and the like have materially improved the quantity and character of forage and are increasing the carrying capacity of the land. In some districts, however, much in the way of better utilization of the range remains to be accomplished.

Range management seeks the maximum production of meat animals and wool consistent with the continued productivity of the forage crop and the needs of other resources. The main difficulty in getting better practices lies in the natural tendency of stockmen to stick to old methods.

Yet improved methods of management often obviate the necessity for reductions in numbers of livestock.

Generally speaking, reductions in herds can be avoided where, through proper distribution of stock, the range is evenly utilized at the right time of year. This requires constant supervision of stock on the range, salting, the improvement of watering facilities, and the construction of necessary control fences. The capacity of a range should not depend upon that available within the immediate vicinity of watering places or localities naturally favored by livestock, while a large portion elsewhere remains unused. Under improved methods not only the present numbers but often a larger number of stock can be carried. The improvement of forage conditions is of material interest to national forest permittees. The Forest Service does not desire to make reductions, but there is often no other recourse.

The past season of adverse climatic and market conditions has emphasized the importance of improved range management. There are places where practically all of the stockmen are going through liquidation, except a comparatively few who have adopted more progressive methods. An individual case will make this point clearer.

Nine years ago a present permittee in the Southwest purchased a ranch and Mexican cattle no better than the average in the locality. He came to the conclusion that fencing would save its cost in reduced outlays for labor, horseshoes, horse feed, and similar items, and that with the better methods which it would make possible a heavy annual loss could be prevented, an increased calf crop and better products obtained, and the range itself greatly improved.

After considerable persuasion adjoining permittees agreed to the plan. He introduced good bulls until all were registered animals, and culled his cattle. Soon he was disposing of about two-thirds of his male increase as bulls, at the best prices in the neighborhood. Fences subdividing his range into pastures made possible a scientific method of rotation grazing. Water was developed and proper care was given his cattle, at reduced expense. All animals were handled in corrals and branded and dehorned in

chutes. Heifers were not allowed to be bred until they were 2 years old.

He obtained an average calf crop of 80 per cent when his neighbors seemed content with 40 or 50 per cent. The average weight of yearling steers, after selling from 50 to 75 per cent of the male increase as bulls, has been from 550 to 600 pounds, which is from 100 to 150 pounds better than the average in that locality. This cattleman has gone through the period of depression without incurring heavy indebtedness and, he says, has made some money. He has a steady contract for delivery of his animals at an advance of \$5 per head over the prevailing range market prices.

The above results are quite comparable to those obtained on the Santa Rita Reserve, containing some 42,000 acres of semidesert range, on which experiments in southwestern livestock production are being carried on. Four experienced cattlemen who have been granted use of the reserve for this purpose are getting exceptional results for the locality. Their calf crop for the past 10 years has averaged 80 per cent, and six carloads of fat cows with an average value of \$25 each, or 4½ cents per pound, were shipped last season; while two carloads of calves brought \$22 each, or 7 cents per pound. These prices are considerably above those prevailing in the vicinity. Losses on the reserve have averaged less than 2 per cent, whereas those of other stockmen in the section have ranged between 8 and 10 per cent. The results of the experiments on this reserve and those obtained on the Jornada Range Reserve and the Great Basin Experiment Station are largely applicable to most of our national forest ranges.

Study of the grazing conditions in northern Arizona has indicated the need for segregating sheep and cattle on allotments exclusive to each class of stock and for placing the permittees as far as practicable on individual allotments with the opportunity and incentive to secure the full benefit of increases in the carrying capacity of the range. It is believed that the principle of individual allotments, under fences where required, can be widely extended, to the advantage of the range users and the benefit of the forage resources.

This policy will require an extensive program of range improvements, par-

ticularly fencing and water development. The cooperation of the grazing permittees can be obtained in constructing a large part of the improvements needed, but the resources of the Forest Service for this constructive betterment of range conditions should be greatly increased and placed on a more stable and assured basis. To this end it is strongly recommended that not less than 10 per cent of the grazing receipts be appropriated currently for range improvements. This would be in harmony with the long-standing legislation which appropriates 10 per cent of the gross receipts from national forests for the construction of roads and trails. It would give the Forest Service normally a fund of \$200,000 a year, which would permit a rapid and sustained advance in building up the productivity and carrying capacity of the national forest ranges.

Grazing fees.—The survey of all national forest ranges to obtain data on which a general revision of the grazing fees might be based was completed in 1924 and recommendations submitted to the Secretary of Agriculture. In view of the economic situation of the livestock industry, the Secretary postponed consideration of these recommendations but approved the following program as a basis for current action:

- (1) Immediate reduction of existing grazing fees where the appraisal has shown the present rate to be in excess of the value of the forage.

- (2) Issuance of 10-year grazing permits, beginning with the season of 1925.

- (3) Except where existing rates are reduced, continuation of present fees during 1925 and 1926.

- (4) A stipulation in the term permits that the grazing fees following 1926 be as determined by the Secretary of Agriculture.

The adoption of this program has permitted immediate progress in stabilizing range use under the 10-year permit plan while affording the department and Forest Service additional time in which to check and review the range appraisals. In order that an impartial review of the whole question of grazing fees might be obtained, the Forester recommended the appointment by the Secretary of Agriculture of a special representative not connected with the Forest Service to canvass the whole matter and make an

independent report. Dan D. Casement, of Kansas, was selected by the Secretary for this purpose.

RECREATION AND GAME

The Forest Service has widely extended the system of roads and trails whereby access is gained to the national forests for their protection and utilization. Located as they are in regions of unusual topographic and scenic interest and abounding in wild life, the forests have developed an enormously important and valuable by-product of public recreation. Within recent years this form of public service has attained astonishing proportions, not because of stimulation by the Forest Service but because the public has discovered and descended upon the national forests.

A policy of exclusion, except during periods of grave emergency, is inconceivable. In all countries the people make such forests outdoor playgrounds. Recreation use, under proper safeguards and supervision, is wholly compatible with timber production and watershed protection and may properly be planned for in systematic forest management. The danger of fire is of course increased by the presence of large numbers of people within the forests, and serious problems of sanitation and supervision arise from their concentration upon small areas. These difficulties accompanying more extensive public use of the forests must be expected and provided for.

The first step in meeting them is to encourage the concentration of recreationists upon selected areas where the hazards are reduced to the minimum and proper supervision is obtainable. The traveler who camps upon an improved camp ground or the summer resident who builds his home in an established summer community is a minimum risk. The principal effort of the Forest Service so far has been to promote this desirable concentration. At present approximately 1,500 small areas are designated as public camp grounds. Upon approximately one-third of these simple facilities such as toilets, fireplaces, and sources of water supply have been constructed. Such improved camp grounds are the cheapest and most effective form of protection, and the 1,000 camp grounds that now lack facilities should be improved as rapidly as possible. The average cost of properly developing a camp ground is approximately \$200.

The expenditure of less than \$250,000 would permit the public to

use with reasonable safety the playground areas most available and valuable.

The great public importance of recreation, susceptible as it is of coordination with timber and forage production and stream-flow protection, makes it desirable to apply to areas of special value for this form of use the methods required for their best development. It is unnecessary and would be uneconomic to eliminate such areas from the national forests for the sake of recreational development, except where their value for public playgrounds is so great as to require a separate and specialized administration. As recreation is a by-product of forest management, so is its administration a by-product of forest administration. It requires no separate overhead or administrative machinery, but can be handled by the same field force required for the protection of the forests and the development of their physical resources. This makes for economy and simplicity of management.

Simple, inexpensive forms of recreation should particularly be encouraged. The system of public camp grounds should be extended. Overregulation of recreational use should be avoided and only such restrictions imposed as are necessary to protect public health and property, to secure reasonably full utilization of recreational resources, and to prevent undue conflict with other forest uses. Charges should be made only where exclusive use of specific tracts is allowed, or other special privileges are granted, or where land is used for commercial purposes. The policy authorized by Congress of issuing permits for individual summer homes or cabins, where they will not interfere with more general forms of recreation, and for the utilities needed for the convenience of the public should be continued subject to equitable rental charges. And plans should be extended for the establishment upon national forest lands of county, municipal, and semipublic and outdoor camps, sanatoriums, and schools.

The annual census of game animals conducted by the Forest Service can not, in the nature of things, be more than an intelligent guess, but it is made by the men most familiar with each portion of the national forests and may therefore be accepted as the best available estimate of the wildlife population. Estimates made at the close of 1924 are summarized by States in Table 13.

TABLE 13.—*Big game animals on national forests—Estimates as of December 31, 1924—Summary by States*

State	Ante- lope	Bear		Cari- bou	Deer	Elk	Moose	Moun- tain	Moun- tain
		Black or brown	Grizzly					sheep	goats
Alaska		5,600	4,900		50,300		545	9,000	400
Arizona	1,421	796	27		49,020	659			64
Arkansas					415				
California	354	7,882			181,800	135			865
Colorado	63	2,720	27		22,673	6,404			4,860
Florida		23			600				
Idaho	1,353	5,352	116	20	49,423	4,404	198	2,582	1,014
Michigan		30			120				
Minnesota		585		22	3,750		960		
Montana	529	4,879	458	20	50,825	9,206	1,120	3,254	1,855
Nebraska					35				
New Hampshire		600			4,000				
New Mexico	728	611			19,418	40			150
Nevada	290	50			3,720				375
North Carolina		50			2,500	20			
Oklahoma	13					300			
Oregon	30	6,102			59,207	3,441			45
South Dakota					1,542	830			
Tennessee		16							
Utah	15	439	12		18,161	1,808			322
Virginia		225			50	80			
Washington		6,805	22	20	23,725	8,498		2,408	25
West Virginia		60							
Wyoming	275	1,501	62		9,253	16,840	2,283		2,458
Total	5,071	44,326	5,624	82	550,567	52,665	5,106	17,244	12,433

The forests also contain a myriad of the lesser animals valuable for fur or sport. Beaver, for example, are reported to be increasing in all localities, and in some are so numerous as to cause appreciable damage.

The Forest Service regards the wild life of the national forests as a major resource of great social and economic importance. Its plans of administration are shaped accordingly. Game management makes a strong appeal to the field officers of the service and upon the great majority of the forests wild life is under constant observation. The States of North Carolina, Tennessee, Oklahoma, Georgia, and Pennsylvania have ceded to the Federal Government full authority to control game upon national forest lands. In the other national forest States the fact that the game ranges are controlled by the Federal Government while the taking of game is controlled by State law is met through cooperative agreements with the State game departments under which most of the field officers of the Forest Service function as deputy State game wardens, the State game officials reciprocating by cooperation in fire prevention. During 1924 forest officers handled 246 cases of game law violations.

An important phase of game cooperation is the establishment of State game refuges within the national forests. At the close of 1924 the number of such refuges was 130; their area totaled 16,346,396 acres. The field officers of the Forest Service actively assist in the protection of these areas. In addition to the game refuges created under State law there are five Federal game refuges which contain a total of 1,002,438 acres of national forest lands, viz, the Grand Canyon Game Refuge, Ariz.; the Pisgah Game Refuge, N. C.; the Wichita Game Refuge, Okla.; the Cherokee Game Refuges 1 and 2, in Tennessee and Georgia; and the Medicine Bow Game Refuge, Wyo.

Not all of the forest lands within the State or Federal refuges are closed to other forms of use, but provision is made to prevent such uses from defeating the purposes of the refuge. Although most of the national forests are used in some degree for the grazing of domestic livestock, there are almost 21,000,000 acres upon which no domestic animals are pastured and where the wild life is entirely free from this competition. Of this total, 14,963,000 acres are inaccessible to domestic animals, 3,844

acres contain excessive quantities of poisonous plants, 2,000,000 acres lack water, 463,000 acres are closed to protect timber, 566,000 acres to protect watersheds, 499,000 acres to protect recreation areas, 2,321,400 acres to protect game ranges, and 59,400 acres are closed for various administrative reasons. These lands occur in many widely distributed areas of variable size and afford game animals isolation and freedom from competition in the use of forage.

Numerous other measures dictated by the requirements of expert game management are carried out by the Forest Service, as for example, special patrols north and south of the Yellowstone National Park to prevent poaching; adjustments in grazing use; planting fry secured from Federal and State fish hatcheries; annual preparation and presentation to the State game commissions of reports describing in detail game conditions and requirements on the national forests of each State; and, in some States, co-operation with State officials in the issuance of trapping licenses.

The count of the southern elk herd conducted on the Teton National Forest in March, 1925, by members of the Forest Service, the Biological Survey, and the Wyoming State game department disclosed a total of 19,493 animals. This represents an increase of almost 110 per cent over the number counted in March, 1921, is only 270 head less than the number counted in 1916, and is 44 per cent greater than the count of 1912. It is now evident that the rise and fall in the numbers of the herd is governed by the annual calf crop and by the winter conditions. As the latter directly influences the survival of the calf crop it may be regarded as the controlling factor. At present hunting is a negligible factor and takes but a fraction of the annual increase. The Yellowstone National Park and the great area of national forest land included within the State game refuge and closed to domestic livestock furnish an abundance of summer feed for the elk. The problem is wholly one of winter food supply.

The initial attack on this problem was to reserve for the elk the forage on areas adapted to winter grazing by them. To this end the Forest Service in 1919 reserved or placed special restrictions on domestic grazing on three

areas aggregating 193,000 acres in the Gros Ventre watershed and the low foothills and benches lying east and south of Jackson Hole.

A count made in March, 1925, showed 9,128 elk on the Gros Ventre area; but during more severe seasons only one-third of this number usually winters in the locality. The use of the other two areas also varies with the winter seasons. Grazing restrictions can never meet the winter requirements of the elk, for forage buried beneath a thick crust of snow impenetrable by weakened animals is valueless, no matter how abundant it may be. The extension of hay production and winter feeding grounds in Jackson Valley is the one certain way by which the southern herd of elk may be permanently preserved in desirable numbers.

The present average production of hay at the Government ranch maintained by the Biological Survey in Jackson Valley is 640 tons. The Izaak Walton League, which has exercised an admirable leadership in the preservation of the southern elk herd, has carefully canvassed the lands adapted to hay production which are contiguous to the Government elk ranch and has secured options upon 2,760 acres, with an estimated annual production of 750 tons of hay. Other intermingled or adjoining ranches, aggregating 2,140 acres and capable of producing 760 tons of hay annually, also are available for purchase. These two groups of holdings, totaling 4,900 acres, combined with the land now in Government ownership, and with the purchases of hay by the game commission of Wyoming would substantially meet the requirements.

Besides their value for hay production these lands are important to the elk for spring and fall grazing, and if publicly acquired would provide an open trail to the forest ranges from the parts of the valley where the elk congregate in the greatest numbers. The purchase of these lands, therefore, seems the most practicable and satisfactory way to settle permanently the problem of the southern elk herd and incidentally to largely eliminate the present difficulty over elk depredations. The latest advices indicate that the necessary lands can be purchased for a total not exceeding \$147,000. Considering the great public value of the elk herd as

a source of food, sport, and scientific study, and the marked diminution in losses which would accrue through the increased feeding facilities, the purchase of these lands would be a matter of good public economy.

The annual rate of increase for elk is estimated to average approximately 28 per cent, which, on a herd of 20,000 animals, would amount to 5,600 head per annum. The best figures available indicate that the average annual kill by hunters is 1,000 head and that the natural loss, other than from severe winters, is about 2 per cent, or 400 head. This leaves a margin of 4,200 head, which may be expected to increase progressively if winter losses are checked by adequate feeding. Obviously such a rate of increase would rapidly overpopulate the range and thus aggravate the present situation. The logical solution is to permit the utilization of a greater proportion of the increase through hunting, even though this necessitates increases in bag limits or reductions in license fees, since it would be more to the public interest to encourage the full utilization of the surplus animals than to have them die upon restricted winter ranges through lack of feed.

In working out the three essential points of the elk policy—that is, the reservation of available winter range, the extension of hay production and winter feeding grounds, and the extension of hunting—the Forest Service will cooperate to the fullest extent of its ability with the State game commission and the Biological Survey.

On the Kaibab National Forest range conditions continue to be serious and the situation of the Kaibab deer herd continues critical. The winter confirmed the previous conviction that the herd has outgrown its available food supply and is threatened with serious depletion unless a constructive plan of game management is applied. The winter losses of mature deer can not adequately be determined, but the loss of fawns was very heavy. As the area is both a national game refuge and a national forest, responsibility for the application of corrective measures rests squarely with the Forest Service, which proposes to redeem

that responsibility to the fullest degree authorized by the Federal statutes and the powers with which they vest the Secretary of Agriculture.

The Forest Service is proceeding with a program along lines recommended by the Kaibab deer investigating committee following its study of the situation on the ground in 1924. Domestic stock grazing will be restricted to the herds of local ranchers dependent upon national forest range. No new permits will be issued, no increases in existing permits will be allowed, and present permittees who abandon their use of the forest will not be replaced.

So far as practicable, the deer herd will be used to replenish other regions. The attempt last spring to move large numbers of deer by driving was not successful, and it is not believed that this form of removal offers a solution of the problem. The most promising method is the capture of young fawns to be raised on cows' milk by local ranchers. The fawns become accustomed to handling and feeding and are more readily shipped. In addition, the capture and shipment of adult deer will be carried on as fully as practicable.

It is not probable, however, that the applications for deer from other regions will keep pace with the natural increase of the herd. To utilize the surplus and hold the herd within proper bounds regulated hunting under special permit will be necessary. This form of use was initiated last fall but too late to obtain full results, so that only 675 deer were taken by hunters. The feasibility of the plan was fully established, however. This fall it will be carried out, as far as practicable, in cooperation with officials of the State of Arizona. No hunting will be allowed adjacent to the highways or areas of recreational use.

WATER POWER

Table 14 shows the status on June 30, 1925, of water-power permits granted by the Department of Agriculture under the provisions of the acts of February 15, 1901, February 1, 1905, and March 4, 1911.

TABLE 14.—*Water-power development and transmission-line rights of way under permit or easement, fiscal year 1925*

Class of permits or easements	Transmissions lines only			Power projects (reservoirs, conduits, and powerhouses)		Total permits or easements
	Permits or easements	Within national forest boundaries	On national forest land	Permits or easements	Estimated average output at minimum discharge	
Permits or easements in force at close of fiscal year:						
Rental—	<i>Number</i>	<i>Miles</i>	<i>Miles</i>	<i>Number</i>	<i>Horse-power</i>	<i>Number</i>
Preliminary.....						
Final.....	132	988.37	740.59	71	549,687	203
Free permits or easements.....	22	155.40	127.83	84	27,191	106
Total.....	154	1,143.77	868.42	155	576,878	309
Construction completed at close of fiscal year:						
Rental permits or easements.....	132	988.37	740.59	66	357,964	198
Free permits or easements.....	22	155.40	127.83	79	26,621	101
Total.....	154	1,143.77	868.42	145	384,585	299
Construction incomplete at close of fiscal year:						
Rental permits or easements.....				5	191,723	5
Free permits or easements.....				5	570	5
Total.....				10	192,293	10

The construction of all transmission-line projects under permit on June 30, 1925, has been completed. Construction has been completed on all power projects except 10, and started on these. The power capacity not yet completely developed is in the main covered by large projects for the completion of which the permits originally allowed considerable time.

The number of permits for power projects outstanding on June 30, 1925, was 18 less than a year previously, and for transmission lines only 12 less. This reduction is owing in part to abandonment, voluntary relinquishment of permits, and revocations for failure to comply with the permit conditions. The remaining terminations were owing to the permittees having obtained permits or licensees under the Federal water power act.

The cooperative arrangement with the Federal Power Commission for administering the Federal water power act continued unchanged. The Forest Service was requested to make engineering reports in 31 cases and to supervise and inspect the operation of 48 permittees or licensees. In all, 159 such requests have been made, with 18 requests to supervise stream-gauging operations.

At the end of the fiscal year the Federal Power Commission had received 624 applications for permits or licenses. Of these 238, or 38 per cent, were for projects involving the use of national forest land. During the year 57 applications involving the national forests were received. This is 51 per cent of the total filings with the Federal Power Commission for that year.

The urgent need for a comprehensive investigation of the water-power resources of the national forests was mentioned in last year's report. The Forest Service has made no start on the study of individual streams, but is cooperating with the American Engineering Standards Committee in a project which has as its objective a uniform method of rating the horsepower capacity of rivers. The present methods of estimating undeveloped power are varied and there is great need for standardization. When agreement has been reached on a uniform method for estimating the power capacity, a study of the streams in the national forests can be made with assurance that the results of that investigation will be entirely consistent with the data for other regions and a contribution toward determination of the water-power resources of the entire United States.

ROADS AND TRAILS

The accomplishments in and expenditures for road and trail building and maintenance, the distribution

among the States of the amounts appropriated and authorized for obligation, and the condition of the five road appropriations on July 1, 1925, are shown in Tables 15, 16, and 17.

TABLE 15.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1925

State	Fiscal year 1925		Total to June 30, 1925				Expenditure to June 30, 1925		
	Constructed		Constructed		Maintained		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles			
Alabama.....					43.0		\$16,640.11		\$16,640.11
Alaska.....	19.0	57.4	145.3	225.6	170.2	225.6	1,985,730.29	\$188,894.72	2,174,625.01
Arizona.....	147.9	112.1	579.9	1,292.0	1,268.0	1,491.0	2,573,337.85	740,400.39	3,313,738.24
Arkansas.....	52.5	50.0	197.7	256.3	183.1	403.4	553,334.63	24,647.73	577,982.36
California.....	235.2	279.6	927.9	1,958.9	1,860.9	3,991.8	6,325,787.15	2,273,302.27	8,599,089.42
Colorado.....	132.7	829.2	803.9	2,010.0	910.1	4,006.1	3,259,318.32	636,977.23	3,896,295.55
Florida.....	29.1		91.7		107.6	36.5	167,368.02	150,851.89	318,219.91
Georgia.....		2.0	13.5	168.6	32.5	168.6	152,988.84		152,988.84
Idaho.....	144.0	508.3	1,410.1	4,073.2	1,082.2	6,148.0	6,305,330.80	1,252,642.96	7,557,973.76
Kansas.....			3.4				2,111.51		2,111.51
Maine.....		1.8	5.0	35.3	7.6	35.3	15,916.90		15,916.90
Michigan.....			40.4		163.0		9,502.08	243.45	9,745.53
Minnesota.....	23.5	7.0	181.5	73.7	189.0	290.0	276,600.41	134,946.41	411,546.82
Montana.....	164.9	491.5	648.3	1,692.6	913.2	5,317.0	3,950,386.71	498,996.51	4,449,383.22
Nebraska.....	3.5		34.9		19.0		37,445.43		37,445.43
Nevada.....	53.9	52.0	366.5	694.5	171.0	525.0	719,089.92	117,260.44	836,350.36
New Hampshire.....	2.9	13.7	17.2	49.2	38.9	301.1	92,509.09	15,181.16	107,690.25
New Mexico.....	102.6	104.0	435.9	1,182.3	923.7	1,182.0	2,053,685.05	229,422.11	2,283,107.16
North Carolina.....	29.5	33.3	52.6	543.1	173.8	543.1	328,093.93	35,924.14	364,018.07
North Dakota.....			1.0				57.75		57.75
Oklahoma.....	5.2	1.4	24.0	16.4	32.7		37,495.67	8,475.11	45,970.78
Oregon.....	237.2	439.6	1,602.8	1,711.0	2,577.0	5,127.4	6,177,370.39	3,942,754.71	10,120,125.10
Pennsylvania.....	16.0		29.0		15.0		11,368.49	1,005.00	12,373.49
Porto Rico.....				30.3		30.3	9,518.77		9,518.77
South Carolina.....			16.3	4.0	49.9		62,044.27	13,515.53	75,559.80
South Dakota.....	22.6	14.0	190.8	34.6	187.6	10.5	436,189.73	156,712.93	592,902.66
Tennessee.....	28.2	46.9	42.4	414.6	15.5	381.7	152,208.42	93,525.66	245,734.08
Utah.....	97.2	367.7	807.5	2,069.0	654.7	1,102.9	1,893,784.39	654,134.82	2,547,919.21
Virginia.....	28.5	80.7	64.2	640.4	152.1	619.2	282,068.83	30,789.66	312,858.49
Washington.....	83.9	335.8	547.7	1,191.5	554.7	4,452.5	3,890,719.35	1,251,524.90	5,142,244.25
West Virginia.....	17.7	13.0	18.7	179.8	20.0	189.8	31,854.22		31,854.22
Wyoming.....	122.0	244.5	722.3	949.9	1,461.8	2,279.3	2,341,951.75	288,005.44	2,629,957.19
Total.....	1,799.7	4,085.5	10,022.3	21,496.8	13,977.8	38,858.1	44,151,779.07	12,740,135.17	56,891,914.24

TABLE 16.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1926*

State	10-per cent fund		Sec. 8 fund		Federal forest road construction fund, total
	Fiscal year 1926	Total	Fiscal year 1926	Total	
Alabama	\$58.93	\$488.36		\$15,456.04	\$1,922.31
Alaska	12,592.48	105,068.43	\$44,002	465,939.82	192,895.97
Arizona	23,868.26	465,920.99	54,251	598,682.80	456,972.12
Arkansas	8,074.56	68,607.01	9,744	172,711.40	129,699.59
California	98,895.28	830,784.07	126,745	1,441,633.87	1,192,650.08
Colorado	43,139.82	469,983.11	67,111	752,522.20	778,000.04
Florida	2,075.58	22,580.29	13,885	119,295.75	22,028.99
Georgia	789.45	5,193.31		40,878.67	134,417.33
Idaho	62,365.04	581,920.25	114,444	1,187,883.85	1,360,323.21
Kansas		1,867.27			
Maine	294.64	1,547.35		32.41	3,738.77
Michigan	63.04	865.75		7.00	3,000.00
Minnesota	2,180.71	19,231.48		7,680.16	108,352.36
Montana	27,782.21	449,287.81	64,950	739,070.16	732,570.45
Nebraska	755.26	13,685.20		18.98	
Nevada	9,815.09	120,883.96	17,573	193,837.23	82,692.76
New Hampshire	3,719.52	19,744.60		354.10	10,902.03
New Mexico	19,266.92	278,291.29	37,491	426,181.99	510,701.58
North Carolina	2,533.85	22,540.01	36,797	97,962.91	176,639.23
North Dakota		45.75		7.00	
Oklahoma	353.77	6,408.43		65.49	2,775.17
Oregon	67,521.68	581,195.19	136,810	1,384,817.48	1,073,208.83
Pennsylvania	6.00	106.00		24.04	21.42
Porto Rico		3.70		7.00	3,343.09
South Carolina	128.78	666.29		467.96	48,280.75
South Dakota	13,144.31	100,767.88	7,483	82,853.73	79,777.92
Tennessee	1,491.49	11,406.49		78,849.43	28,351.90
Utah	20,417.05	286,657.87	38,047	441,345.30	465,226.64
Virginia	3,411.99	21,659.06		60,965.31	71,404.89
Washington	39,519.89	321,783.58	85,506	931,774.30	716,042.79
West Virginia	348.31	2,404.28		5,921.47	5,049.24
Wyoming	32,567.66	277,235.48	45,161	459,919.47	549,401.48
Special fund			100,000	100,000.00	
Undistributed				192,832.68	59,609.06
Grand total	497,181.57	5,088,330.54	1,000,000	10,000,000.00	9,000,000.00

State	Forest highway fund		Forest development fund		Grand total
	Fiscal year 1926 (authorized)	Total	Fiscal year 1926 (authorized)	Total	
Alabama	\$3,259	\$12,283	\$6,884	\$18,891	\$49,040.71
Alaska	463,843	2,155,668	15,293	116,767	3,036,339.22
Arizona	278,684	1,311,139	129.43	686,907	3,519,621.91
Arkansas	33,825	155,045	50,958	199,127	725,190.00
California	683,034	3,210,666	409,132	1,808,402	8,484,136.02
Colorado	336,974	1,580,967	154,674	834,130	4,415,602.35
Florida	9,854	51,761	18,113	35,823	251,489.03
Georgia	10,746	34,092	16,331	57,834	272,415.31
Idaho	511,777	2,403,615	620,400	2,887,860	8,421,602.31
Kansas					1,867.27
Maine	1,266	6,001	466	10,072	21,391.53
Michigan	2,350	9,647	18,599	31,571	45,090.75
Minnesota	30,523	138,901	62,746	172,203	446,368.00
Montana	405,094	1,917,163	299,459	1,684,242	5,522,333.42
Nebraska	5,128	24,195	1,071	23,162	61,061.18
Nevada	97,249	456,947	6,364	89,145	943,005.95
New Hampshire	16,047	76,340	15,481	65,301	172,641.73
New Mexico	212,453	1,000,924	73,062	482,346	2,698,444.86
North Carolina	13,455	62,169	29,373	125,953	485,264.15
North Dakota					52.75
Oklahoma	2,381	12,072	3,018	21,250	42,571.09
Oregon	581,745	2,645,342	457,729	2,058,128	7,742,691.50
Pennsylvania	3,801	6,832	10,069	28,485	35,468.46
Porto Rico	666	3,160	153	10,965	17,478.79
South Carolina	1,616	4,360	5,622	23,750	77,525.00
South Dakota	35,280	167,911	26,368	112,907	544,217.53
Tennessee	9,523	45,019	19,454	67,581	231,207.82
Utah	173,243	814,974	54,984	344,986	2,353,189.81
Virginia	15,371	62,962	29,481	125,313	342,304.26
Washington	330,675	1,556,555	357,122	1,722,995	5,249,150.67
West Virginia	5,033	18,291	13,466	43,632	75,297.99
Wyoming	225,100	1,054,999	94,635	610,272	2,951,827.43
Special fund					100,000.00
Undistributed					252,441.74
Grand total	4,500,000	21,000,000	3,000,000	14,500,000	59,588,330.54

TABLE 17.—Condition of road appropriations on July 1, 1925

Fund	Total appropriations to June 30, 1925	Total expenditures	Unexpended balance
10 per cent.....	\$4, 591, 148. 97	\$4, 081, 436. 13	\$509, 712. 84
Section 8.....	9, 000, 000. 00	7, 951, 750. 30	1, 048, 249. 70
Federal forest road construction.....	9, 000, 000. 00	8, 855, 062. 85	144, 937. 15
Forest highway.....	16, 500, 000. 00	12, 839, 137. 82	3, 660, 862. 18
Forest road development.....	11, 500, 000. 00	9, 285, 668. 83	2, 214, 331. 17
Total.....	50, 591, 148. 97	43, 013, 055. 93	7, 578, 093. 04

My report for the fiscal year 1922 dealt in some detail with the development and purposes of national forest road work construction and the various laws and appropriations providing for it. The progress since made calls for a further résumé.

As was then explained, Federal funds for national forest roads and trails have been made available under four separate legislative measures. The oldest of them first appeared in the agricultural appropriation act of August 10, 1912, and was made continuing legislation the following year. It created what is commonly designated the "10 per cent fund," consisting of 10 per cent of the annual receipts from the national forests.

The second measure was enacted July 11, 1916. Section 8 of the Federal road act of that date appropriated \$1,000,000 annually for 10 years beginning with the fiscal year 1917. This appropriation created what is known as the "section 8 fund."

The "Federal forest road construction fund" was created by the Post Office appropriation act of February 28, 1919, making available \$3,000,000 annually for three years. Finally, the Federal highway act of November 9, 1921, created two distinct funds, the "Forest highway fund" and the "Forest development fund."

The Federal highway act itself carried appropriations of \$9,500,000 and \$5,500,000, respectively, for these two funds. The Post Office appropriation act for 1922 authorized but did not directly appropriate an additional \$13,000,000 to replenish these funds for the fiscal years 1924 and 1925. For each of the fiscal years 1926 and 1927 a further appropriation of \$7,500,000 has been authorized by Congress.

The sums that have hitherto been actually appropriated for forest high-

ways and forest development roads under these authorizations and their distribution between the two funds are shown below.

Fiscal year	Forest highway fund	Forest development fund
1922.....	\$2, 500, 000	\$2, 500, 000
1923.....	7, 000, 000	3, 000, 000
1924.....	3, 500, 000	3, 000, 000
1925.....	3, 500, 000	3, 000, 000

The purpose of the forest development fund is primarily to build and maintain roads and trails needed for the protection and use of the forest resources. The purpose of the forest highway fund is primarily to construct roads which, while serving the national forests, form part of the public highway system of the States in which the national forests are located and which in consequence have a proportionately diminished area of taxable lands. The 10 per cent fund is now almost wholly used for the maintenance of forest development roads and trails. The so-called Federal forest road construction fund has practically all been expended and no longer needs discussion. The law creating the section 8 fund, while based in part at least on recognition of a responsibility of the Federal Government, created by land ownership, to aid local highway development, and while making local cooperation in the work obligatory, had definitely in view both forest development and community service, going hand in hand.

While the forest highway fund, unlike the section 8 fund, may be used by the Secretary of Agriculture with sole authority for initiating and approving projects, it has similarly in view the construction and improvement of roads, necessary to the for-

ests. that are also needed as part of the public highway system. Therefore, the regulations for administering the fund provide for obtaining the recommendations of local public agencies. Under the procedure established, the determination of the existing and proposed roads which are deemed necessary and the annual selection of the projects to be constructed are co-operative undertakings in which the State, the counties, the Forest Service, and the Bureau of Public Roads participate. All projects are considered at a conference of the State highway department, the district forester, and the district engineer of the Bureau of Public Roads. From such projects the representatives of the Federal bureaus select those which they believe should be approved, final decision resting with the Secretary of Agriculture. The appropriation may be expended for roads on the State, county, or community highway systems.

The regulations for administering the forest highway and forest development funds recognize on the one hand the advantages to be gained by utilizing the technical engineering services of the Bureau of Public Roads and on the other hand the opportunities offered by the field organization of the Forest Service and the close connection between road and trail work and other activities in the national forests. All projects financed from the section 8 fund, those financed from the forest highway fund and costing \$2,000 per mile or over, and those financed from the forest development fund and costing more than \$5,000 per mile are constructed under the supervision of the Bureau of Public Roads. This bureau also supervises other forest road work which requires the technical services of a highway engineering organization.

In the construction of the cheaper roads the Forest Service utilizes its field organization of supervisors, rangers, and other officers, and correlates this work with its fire-control activities by placing construction crews where they will be available for fire suppression during danger periods. The contributed time of forest officers is charged to the road and trail funds, while any time of the road and trail crews given to other activities is charged accordingly. This close coordination permits better protection of resources and lowers the cost alike of the roads and trails and of national forest administration.

Trails are primarily for administration and protection, but to some extent are used by the public. The forest development roads are likewise open to public travel and really constitute a portion of the public highway system. The true distinction between forest highway and forest development roads is in their relative importance for public travel and for the needs of the national forests themselves. Trails required for forest protection are given the highest priority. In forest-development road projects preference is given in the following order:

(1) The repair and partial reconstruction of existing roads to make them more useful and to reduce high maintenance costs, because of poor location, excessive grades, etc.

(2) New roads which will open up large regions now inaccessible, primarily for protective and administrative service.

(3) Roads required specifically for fire control or administration.

(4) Roads for the utilization of forest resources.

(5) Roads primarily for the use of people who wish to visit or utilize the national forests.

MAPS AND SURVEYS

During the year 59 maps of the national forests were compiled and 91 printed. The demand by the public for these maps increases each year, and it has been difficult in some districts to supply the numerous requests.

A large part of the entire national forest area is unmapped. As topographic maps are required for prospective timber sales and fire-protective work, special surveys of small detached sections are made by the Forest Service.

RESEARCH

FOREST EXPERIMENT STATIONS

The plan formulated several years ago by the Department of Agriculture for a national program of investigation in the art of growing timber called for 10 or 12 regional forest experiment stations. Six are now established. The southern forest experiment station, with headquarters at New Orleans, is studying the timber-growing problems of the great pine forests of the South Atlantic and Gulf Coast States and the hardwood forests of the southern Mississippi, one of our

last great timber reservoirs. The Appalachian station, at Asheville, N. C., is working in the southern Appalachian hardwood forests, with their many complex forest problems. The Northeastern station, at Amherst, Mass., working in the extensive pine, spruce, and hardwood forests of New England and New York, is adding the weight of accurate knowledge to the many forces making for forestry in that region. In Michigan, Minnesota, and Wisconsin the Lake States station, with headquarters at St. Paul, is helping to lay a sound technical foundation for the greatest reforestation task in the United States, of which the rehabilitation of 20,000,000 acres of denuded land is only a part.

The Northern Rocky Mountain station, with headquarters at Missoula, Mont., while primarily useful to the national forests of Montana and northern Idaho, will be of increasing value to the lumber operators of the white pine and western yellow pine forests as they come to understand the opportunities for continuous forest production. The Pacific Northwest station, with headquarters at Portland, Oreg., and serving the territory of Washington, Oregon, and southeastern Alaska, has an unusual opportunity to help both the national forests and the forest industries because of the high productivity of the forests of that region and the consequent opportunities for profitable timber-growing on an intensive scale. In addition to these larger stations the Forest Service maintains two smaller stations in the central and southern Rocky Mountain region, one at Colorado Springs, Colo., and one at Flagstaff, Ariz.

Recognizing the need for a forest experiment station in California, Congress last year authorized an appropriation for it, but has not yet provided funds. California, with its 12,000,000 acres of virgin forests, has great possibilities for forestry because of its favorable climate and soil and valuable tree species. Already there is great demand for information looking to better management of forest lands. Cutting has made heavy inroads, and is now advancing at the rate of over 50,000 acres a year. Nearly 3,000,000 acres of once forested land in California have been reduced by the ravages of fire to useless brush fields which no longer produce timber. Some of these lands are being slowly reclaimed by forest, but by far the larger part of them are wastes, producing no revenue

and creating by their very existence a fire menace to the adjoining forests. Measures must be worked out through research to assist nature to reforest these brush fields naturally or to restock them artificially by planting or seeding.

In addition to the problems of timber growing and protection California has a difficult problem in the management of its brush-covered watersheds—the so-called dwarf or chaparral forests of southern California—from which much of the water supply for cities, irrigated farms, and hydroelectric plants is obtained. Even now southern California appears to be approaching the limit of available water. Through intensive protection of the brush fields and perhaps by afforestation or by introducing new soil-binding plants it may be possible to increase the low-water supply in the streams and artesian basins. No less important are measures to reduce the floods that now sweep from denuded mountains and bury fertile farm land under boulders and gravel. The proposed experiment station would find southern California one of its most useful fields.

Additional stations are needed in the Ohio-Mississippi Valley and the Middle Atlantic States. In the region that embraces Ohio, Indiana, Illinois, Iowa, and Missouri there are about 40,000,000 acres of forests, which are highly important to the full development of agriculture and from which surplus timber can be shipped at low transportation costs to the large urban populations near-by. The region is one of great forest productivity on account of the favorable climate and good soils. Intensive timber growing will be an essential part of diversified farming, for in this rich agricultural region there is in the aggregate a large amount of land, usually in small units, that is too rough or sterile for cultivation. Intensive methods of farm forestry must be worked out for the many tree species and forest types. A station in the Middle Atlantic States is needed, because that section can not be effectively served by the Appalachian station to the south or by the Northeastern station to the north, by reason both of distance and of divergent problems. When these stations are established, and the Central Rocky Mountain and the Southwestern stations are increased to an adequate size, the forest regions of the entire country will for the first time be provided with fairly adequate research

facilities for public and private timber growing.

The field is immense and the problems innumerable, but an excellent beginning has been made. As timberland owners gain better understanding of forest management as a practical business undertaking they are beginning here and there to hold their lands for a second crop—a policy that, followed out, will permit permanent forest industries based on keeping forest land productive. How much timber their lands are capable of producing, whether they should plant or depend wholly on natural reproduction, what protective measures are necessary to safeguard their investment, what steps are to be taken to produce full timber crops without unnecessary loss of time, are questions that owners are beginning to ask and that experiment stations are preparing to answer. We can not afford to depend on crude methods of timber growing; our forest problem demands speed of attack. As in other industries, scientific research can span in a decade fields of knowledge that without it might take generations to toil through. Already the forest experiment stations are becoming centers of information on forest practices and policy. They are an essential part of the forestry movement. It is important that the forest experiment station program go forward to completion, and that thereafter the stations keep abreast of the growing demand for facts.

FOREST ECONOMICS

The timber supply problem of the United States involves many complex economic factors. The land problem is a single phase. It presents such features as great concentration of timber holdings, with the tendency to wasteful overcutting to meet carrying charges; shifting land tenure and the dumping of denuded land onto the public rather than pay taxes; the question of public versus private ownership; and other problems of unique and pressing difficulties.

Equally difficult and complicated are the financial problems of the timber industry. Competitive price cutting between different forest regions; overcutting of timber to liquidate large investments in timber reserves; overinvestment in sawmill equipment; transportation costs to principal consuming points; trends in lumber consumption and prices—such factors vitally affect the stability of the lumber industry and have an important

bearing on the development of timber growing as a business. At the very heart of the forest problem is the question, What are the costs of destructive logging as compared with the costs of timber growing? Is the lumber industry wise in destroying the productivity of its forest lands—in treating them, in the language of the tax experts, as “wasting assets”? Is the Nation wise to tolerate this destruction of a capital resource? This is the ultimate question to which most of the studies in forest economics are tending. The business of timber growing must have a firm economic foundation and the public interest must be safeguarded. In seeking a more exact knowledge of the economics of forestry the Forest Service is serving both these ends.

The Clarke-McNary law has afforded the means for a thorough study of forest taxation that promises to be one of the most important economic investigations undertaken by the Forest Service. Among the economic studies now under way, one deals with the trend of prices for standing timber and of sawed lumber for as far back as records are obtainable; another with interstate lumber distribution, which has become more elaborate and costly as the forests have receded before the sawmills. A study is being made of lumber transportation and the increasing national freight bill on lumber. The economic consequences of forest destruction in Michigan have been thoroughly studied on the ground and the results will soon be published. These are typical examples of the sort of economic research the Forest Service is doing. It is work that needs to be enlarged in order that forest policies may be based on sound economic knowledge.

The Nation has reached the point where it needs an exact inventory of its forest resources. We need to know more accurately how much ripe timber we have, how much young growth of various ages and species, and how much devastated land needing rehabilitation. How fast will different species of timber grow in different forest soils and regions? How much timber do local wood-using industries and populations need for their normal economic development? Who own our forest land and what are they doing with it? How strong is the movement toward larger holdings of old-growth timber and toward dissipating holdings of cut-over land?

Numerous estimates of our forest resources have been made in the past;

in 1910 a study was made of forest ownership; at various times in the past 20 years studies have been made of consumption of timber by wood-using industries. But these studies have been mostly sporadic and piecemeal and often based largely on crude estimates. Various agencies have made them—Federal, State, and industrial. The Southern Pine Association in the past year has made a survey of the southern pine industry. The timber problem, however, is a national problem, and a simultaneous, nation-wide stock-taking is needed. Such an inventory would serve as a guide at once to public policy, to timber manufacture and commerce, and to commercial forestry. Provision should be made at an early date for this investigation, which should be directed by Federal agencies with the cooperation of the States and industrial organizations.

FOREST PRODUCTS INVESTIGATIONS

Place of research in preventing timber waste.—The widespread interest in the National Conference on Utilization of Forest Products and, following the conference, the formation of the National Committee on Wood Utilization under the auspices of the Department of Commerce, are evidence that the public and the industry are alive to the importance of a program to reduce the waste of forest products. The program to be undertaken by the committee combines a general effort by industry to reduce waste with investigation and research, principally by the Government, to find out what the chief wastes are and how to reduce them. No other agency is so well equipped as the Government to carry on the research and the extensive industrial surveys that will be needed as this movement gets into full swing.

One of the first things to find out is the quantity, character, and location of the wood now unutilized or poorly utilized. It is known that the amount of wood wasted in the forest is very great. Logging operations leave on the ground from 20 to 30 per cent of the timber, chiefly in the form of so-called "inferior" species, defective logs, high stumps, and large tops. Of the original tree in the forest only about 35 per cent leaves the sawmill in the form of lumber; frequently only two-thirds of the lumber bought by wood-using plants for further fabrication comes out in the form of finished products. Better information on these wastes will greatly help the committee in proceeding with its program.

An inventory of wastes ought to go hand in hand with an enlarged program of Government research to determine practicable means of preventing these wastes or of finding uses for waste material. The white fir of the Pacific Northwest, for example, is a wood on which information is meager. Its very restricted use is due partly to trade custom and partly to incomplete knowledge of its properties. Investigations of the amount of this wood available, its properties, the proper methods of manufacturing and seasoning it, and the uses it is well suited to serve will give the basis of fact needed for a program to lessen the waste of this species and thus reduce the drain on other more valuable woods.

Sawmill waste offers a great opportunity for research. Of the logs entering a sawmill 45 per cent is lost in bark, sawdust, slabs, edgings, and trimmings. In many cases part of the material might be salvaged. The species of timber, the character of waste, and local economic and transportation conditions make for each region, for each group of mills, or for individual mills separate and distinct problems. In some instances the outlet for mill waste will be found in paper pulp; in other instances in wallboard, fuel briquettes, small ready-cut stock, or distillates. In other cases investigation might show that waste once developed could not be disposed of profitably and that the solution would be prevention rather than cure. Careful regional studies of the waste problem may result in bringing together sellers and buyers of waste wood or in establishing new industries to make use of it.

The knowledge obtained by such investigations added to the large amount of knowledge on wood products obtained in the past by the Forest Products Laboratory and other agencies will give the technical basis for the work of the committee on wood utilization. At this point begins the very human and difficult problem of getting this knowledge put to use in a vast multitude of shops and factories, trades and crafts, in the face of tradition, custom, prejudice, and inertia. It is a problem of educating many men in new ways, beginning with leaders and managers of industry and working down through the rank and file. It will be a continuing process for which many methods and agencies must be used—publicity, demonstrations, articles, lectures, special educational courses, and above all coop-

eration by the industries most concerned.

The reduction of timber waste means in the long run something more than supplying the country's immediate need for timber, something more than a more efficient industry. A well-coordinated industrial structure that would utilize the full product of the forest holds a large promise, in a human and social way, to communities that depend on the products of the forest for their existence and to the Nation that demands an ever-increasing supply of wood. It is only by timber growing, by continuous forest production, that such communities can be made permanent and can enjoy the benefits that permanency gives, and its is only by timber growing that the Nation can be assured of the safety of its forests. Timber growing as a practical business venture will advance as good utilization advances and makes the forest crop more valuable, and forest products research, in pointing the way to good utilization, is hastening the day of timber growing as a big-scale commercial enterprise.

Work of the Forest Products Laboratory.—

The Forest Products Laboratory devoted particular attention during the year to an analysis of the sizes and qualities of lumber required by the various wood-consuming industries, primarily to meet requests from groups concerned with finding useful outlets for wood waste and from the central committee on lumber standards for a thoroughgoing analysis of hardwood lumber grading, with the object of improving the grading rules. A close study of the way hardwood-using industries cut up their lumber, the sizes used for typical products and the quality of cuttings, their properties, and allowable defects gave a basis for recommending standard grading rules. Besides developing a grading system which minimizes waste, the studies constitute the first definite step toward standardizing small ready-cut or "dimension" stock, the importance of which in waste reduction can hardly be overestimated.

At the request of the general standardization conference, of April, 1924, actual or potential markets in the industries for short lengths of softwood yard lumber were studied and reported on. The purpose was to ascertain under what conditions and to what extent yard lumber under 8 feet in length is purchased by fabricating industries. Aside from the im-

mediate bearing of the investigation on American lumber standards, the major objective of this work is to make known, particularly to lumber manufacturers and merchandisers, the conditions that must be complied with in getting into use certain unpopular sizes and grades of material that now form a heavy and wasteful burden to the sawmill. Few of the industries that saw up lumber into small cuttings for fabrication now buy other than long boards and standard grades, but with the establishment of standard small sizes many of them can be expected to purchase ready-cut stock which the mills can produce advantageously from waste or low-grade material. The findings from this analysis lend strength to the position previously taken by the Forest Service that the saving of this wasted material can be made at a profit to the industries concerned and with a reduction in timber drain. The work thus far done, however, only begins the coordinating of lumber production and lumber use.

What should be the thickness of the standard "1-inch" board is a question still before the lumber trade in its efforts toward standardization. Although the disagreement centers round only one thirty-second of an inch of thickness, its importance as affecting good utilization warrants the time and thought that have been brought to bear on it during the last three years. The standard thickness adopted must reflect close and thrifty practice in the sawmill so as to make the log produce as many standard boards as possible. Lowering the cost of lumber transportation is another consideration that has contributed to a gradual reduction in thickness. This tendency must be stopped at the point where utility is interfered with, for real economy demands a serviceable and wear-resisting product. The Forest Service, weighing the mechanical requirements that the standard board must meet for various uses, recommended last year a thickness of thirteen-sixteenths inch.

Although the position of the Forest Service was supported by important consuming and distributing groups, the producers were generally of the opinion that twenty-five thirty-seconds inch was preferable. A compromise resulted in a dual standard, the so-called "standard" and "extra standard" boards. Renewed efforts toward a single standard at the conference

held in Washington last May resulted in a request to the laboratory to investigate further, in consultation with a committee of the building trade, and make next year a final and fully considered recommendation. The laboratory is working toward that end.

The wide range of laboratory investigations permit mention only of a few results as typical. Investigation of the influence of growth conditions on the strength of hickory and elm showed that proper silvicultural thinning both increases the rate of growth and produces wood of the highest strength. An extensive series of tests recently completed has shown that defects such as knots, checks, and shakes in large wooden columns are not so detrimental to strength as was commonly supposed. As a result construction costs can be reduced by using material of a lower grade and often of smaller sizes.

The redesign of wooden shipping containers for dynamite, made possible as a result of cooperation with manufacturers of explosives, will result in an annual saving estimated at \$250,000 in cost of lumber and shipping charges. A further study shows that fiber-board boxes may safely be used for the transportation of explosives. The development at the laboratory of improved technique in the steam bending of wood makes possible a decrease in the size of bending blanks, a radical reduction in breakage, and a further saving of material through the substitution of bending for band sawing throughout a wide field of wood manufactures.

Considerable progress was made in developing a method of wood preservation which can be used by farmers and other occasional consumers of treated timber who are barred from access to the larger plants by reason of costs and who are unable to obtain coal-tar creosote in small quantities except at a high price. The process under consideration consists of a simple steeping or soaking of the material to be preserved. The effectiveness of the steeping of posts, poles, or other timbers with zinc chloride or sodium fluoride has been thoroughly demonstrated. These preservatives are obtainable, even in small quantities, at a very low cost, and the only equipment required is a tank of the proper size.

A study of the painting characteristics of various woods is beginning to yield information on the causes of early failures of paint on certain

woods. Such studies give promise of developing for each species the proper methods of painting to retard weathering of the surface, thus saving a vast sum in the Nation's bill for new lumber.

A series of air-seasoning experiments in cooperation with the National Hardwood Lumber Association was recently begun at five mills in the South. The object is to determine the extent to which the present air-seasoning practice in the southern hardwood field can be improved, particularly to prevent the staining of sap gum and to reduce surface checking in oak.

RANGE INVESTIGATIONS

The general drought and resultant overgrazing of ranges in 1924 in practically every section of the far Western States emphasized the necessity for a better solution of the problems of forage production on the ranges and of methods of utilization which will give more stable production. It is a problem of building a profitable livestock industry on ranges where at the same time timber production must be maintained, water supplies protected, and eroded watersheds restored. The wide diversity of the physical, climatic, economic, and other production conditions complicates the problem. Improved range management is a prerequisite to improved conditions in range stock growing. Studies throughout the national forests to solve the present critical situation, assist in maintaining the livestock industry on a profitable basis, limit the necessary reductions in grazing, and diminish the serious effects of drought are urgent.

General conclusions in regard to saving livestock from starvation on southwestern ranges were published as a Farmers' Bulletin. Manuscripts were submitted for publication regarding: "Range Watering Places," "The Use of Salt in Range Management," "Range Readiness and Forage Production," "Important Western Browse Plants," "Range Utilization," and "Artificial Reseeding of Depleted Range Lands."

A four-year study of the utilization and management of browse range in southern Utah has shown that the basis of stocking should be proper utilization of the herbaceous and more palatable browse vegetation, with utilization of the less palatable species confined to what will be grazed incidentally in connection with proper

use of the other forage. These findings are of great importance for the extensive browse areas, which have been generally too heavily stocked, with resultant injury to range and watershed and frequently uneconomical production of livestock.

Because of the long-continued drought in the Southwest the growth of forage on the Jornada Range reserve was so far below the needs of the stock occupying the area that it became necessary to remove all the cattle. This brought to a complete cessation the many years' work carried on through cooperation with an owner who furnished and handled the cattle used in the experiments. The rainfall for the summer of 1925 was so deficient that restocking is not to be considered until 1926 at the very earliest, and not then unless there is sufficient forage on the ground to make certain that the area has recuperated enough to permit moderate restocking without danger of overgrazing. A new cooperator is ready to enter into an agreement with the department to take over the range.

The cooperative studies of the spring-fall range at the Bureau of Animal Industry sheep experiment station in Idaho were expanded. Cooperative experiments were undertaken on range sheep management in Montana with the Montana Agricultural College, on supplemental feeding of range cattle in New Mexico with the New Mexico Agricultural College, and on range revegetation in Utah with the agricultural college of that State. The cooperative experiments with other State agricultural college experiment stations were continued.

Active cooperation has been established between the Forest Service and the Extension Service of the Department of Agriculture and the extension services of the western State agricultural colleges in the handling of the extension program of range management. In a number of States groups of county agents were taken over parts of the national forests and shown the results of range investigations and the application of better range-management principles.

In August, 1924, a two-day field demonstration of the practical results of the range investigations at the Great Basin Experiment Station, held in cooperation with the Utah Extension Service, was attended by about 125 stockmen and other interested par-

ties. The success of the demonstration warrants its periodic repetition. Another will be held in 1925.

Nearly 3,000,000 acres of national forest range land were covered by grazing reconnaissance, and definite plans developed for their administration and management. Approximately 23,000,000 acres or slightly more than one-fourth of the total range lands in the national forests have now been covered. More rapid progress should be made in determining accurately just what our grazing resources are and how they may be managed to serve their part in the permanent social and economic development of the West.

INFORMATIONAL AND EDUCATIONAL ACTIVITIES

The size and varied nature of the educational effort required to give forestry its due place in our national economy has been one of the underlying themes of this report. In brief, the chief objectives of the current activities of the service in this field are:

- (1) Reduction of man-caused forest fires in every part of the country, but most of all on the national forests, where expenditures for fighting fires and damage to resources directly affect the Federal Treasury.

- (2) Promotion of the best relationships between the national forests as going business enterprises and the public which uses and owns them.

- (3) Facilitation of the onward spread of timber-growing and better timber utilization by making widely known and getting into actual practice the methods that should be followed.

Reports of previous years have covered the plan of organization under which the informational and educational work of the Forest Service is carried on and the methods employed in its prosecution. Distinct progress was made in defining local objectives and integrating the work with the other duties of forest officers in due balance. In preparing the individual forest plans, which lay out every year the tasks to be undertaken and the time allotted each task, particular consideration is given to the reasons for the man-caused fires that have occurred, and how to reduce their number.

Forest rangers regularly visit the schools in their districts to explain the importance of fire prevention and enlist the interest of the children in

their work. Many public talks were given before civic and commercial organizations and other audiences; the most effective use of signs, posters, and publicity devices of various kinds was studied; and cooperative relations were maintained with the local press. On two forests on which incendiarism is common, because of traditional local custom and deep-seated belief in regular woods burning, educational campaigns were carefully planned that include a tour of the scattered small communities with a motor truck equipped for projecting motion pictures and lantern slides. These campaigns will be made in the fiscal year 1926.

Work involving the production and use of motion pictures and exhibits of various kinds is carried on in close cooperation with the offices of motion pictures and exhibits in the departmental extension service. New motion pictures were obtained illustrating approved methods of planting in the Southern States, scientific developments in the turpentine industry, ways of preventing loss of lumber in industry, and how the Forest Service handles its timber sales. In cooperation with the Bureau of Animal Industry, a two-reel picture on the destructive custom of firing the woods was produced.

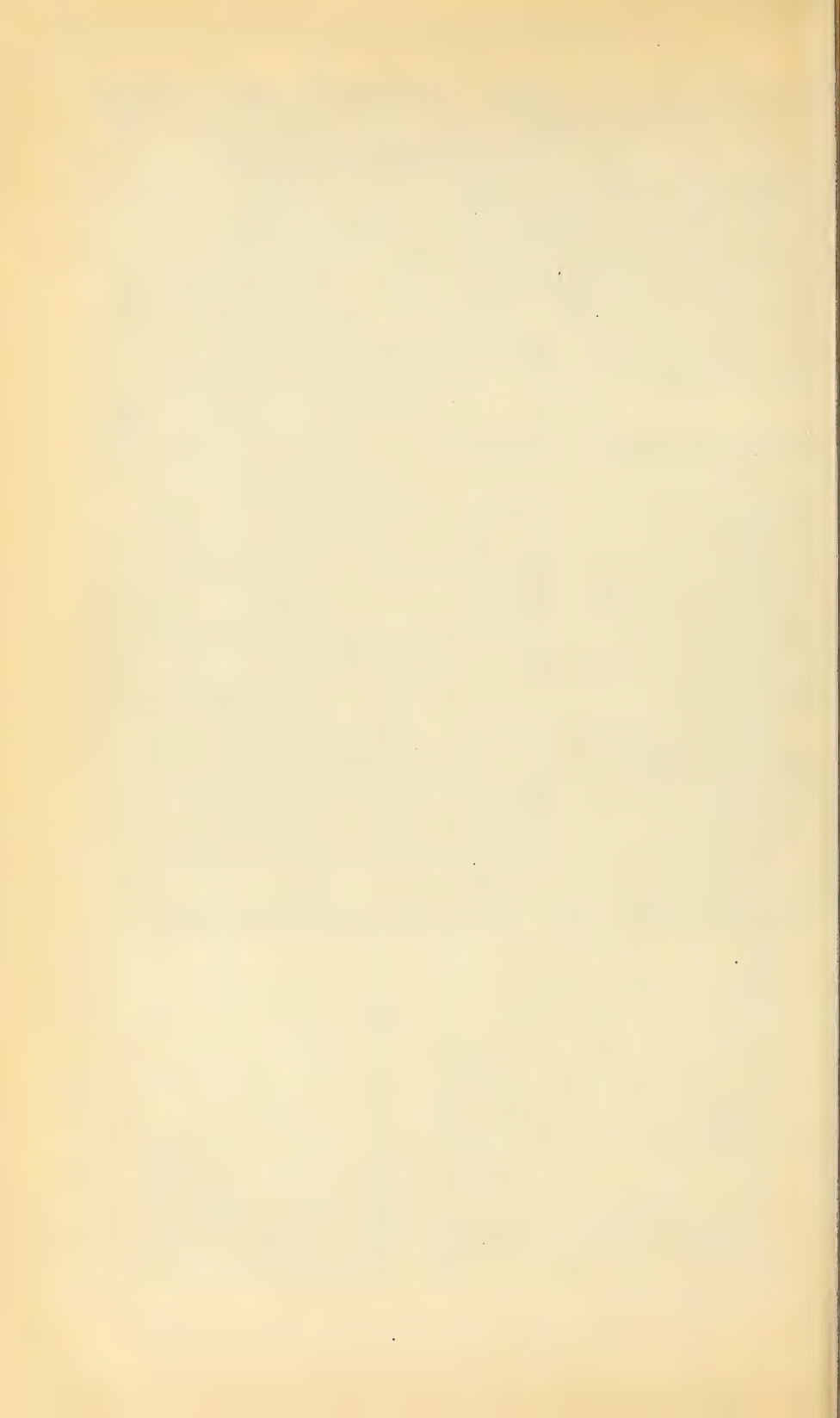
One of the most formidable public relations problems is created by the increase of automobile touring, which brings into the national forests of the West hundreds of thousands of people unacquainted with local conditions and unaccustomed to care in the use of fire in the woods. Something in the nature of mass education is necessary, as distinguished from what has been done successfully and widely through the efforts of forest officers

with individual communities within or near the forests. In the crisis created last year by the extraordinarily severe fire conditions in California a state-wide drive for fire prevention attained unparalleled proportions.

This was the result of a thoroughly aroused public sentiment throughout the State, which caused many and diverse agencies, both civic and commercial, to join hands with the Forest Service, the State forestry department, and each other in a common campaign. Many thousands of dollars were spent by these local bodies and companies along advertising and publicity lines. While it is necessary to avoid drawing too hasty conclusions, on the face of the statistics available for the 1925 season the 1924 campaign seems to have borne very definite fruit in the form of fewer man-caused fires this year, in addition to the immediate benefits of the campaign in 1924.

One conclusion can certainly be drawn—that the key to public education for fire prevention on a large scale is organization of the many agencies now willing to join hands in such an undertaking. Use was made of this spirit of cooperation in what was perhaps the most outstanding advance of the year in the field of public relations—the establishment of American Forest Week as a nation-wide observance sponsored and promoted by a voluntary association of nearly 100 organizations of the most diverse character uniting to form the American Forest Week Committee. That since the close of the fiscal year this committee has placed itself permanently in the field, headed by ex-Gov. Frank O. Lowden, of Illinois, as chairman, is a cause for deep congratulation to all interested in the future of forestry in the United States.

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REPORT OF THE CHEMIST

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 15, 1925.

SIR: I beg to submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1925.

Respectfully,

C. A. BROWNE, *Chief.*

HON. W. M. JARDINE,
Secretary of Agriculture.

The Bureau of Chemistry promotes agriculture and the industries that make use of agricultural products by scientific research in agricultural chemistry and by the application of the results of such research to the solution of the problems involved in the production, preservation, and profitable utilization of farm crops. It conducts biological investigations of food and drug products and studies the physiological effects of such products on the human organism. It develops methods for the manufacture of table sirups and sugar. It investigates chemical problems relating to the composition, manufacture, action, and application of insecticides and fungicides. It conducts experimental work in the utilization, for coloring, medicinal, and technical purposes, of raw materials grown or produced in the United States. It investigates and develops methods for the prevention of grain-dust, smut-dust, and other plant-dust explosions and fires, including fires in cotton gins and cotton-oil mills. It investigates and demonstrates improved processes for preparing, weighing, handling, transporting, and utilizing rosin and turpentine. It collaborates with other departments of the Government which ask the Secretary of Agriculture for assistance in chemical investigations.

The Bureau of Chemistry is charged with the enforcement of the tea inspection act, the naval stores act, and the food and drugs act, and is authorized to make the necessary investigations to regulate interstate and foreign commerce in the products covered by these laws.

THE CHEMISTRY OF CROPS

Fundamental studies of the factors affecting the composition of crops and crop plants were continued. Previous work has shown that the protein content of wheat can be materially increased by the application of fertilizer at certain stages of growth. The market value of wheat is increased by increasing the protein content. In developing methods for the practical application of fertilizer to wheat at various stages of growth it was found that by so spacing the rows as to permit the application of the fertilizer not only was the quality of the wheat improved but the quantity of the yield for a given area was not decreased. As the spacing of the rows made it possible to cultivate the soil between them, experiments were carried on to determine what effect such cultivation would have on both the quantity and quality of the crop. Many data have been acquired as the result of these experiments, but additional experimental work is necessary before final conclusions can be reached.

To ascertain whether or not the principles already worked out for wheat hold with rye, experiments were begun on the effect on yield and composition of the time of application of sodium nitrate fertilizer to rye. A start was made in a study of the absorption of phosphorus by wheat and rye.

Experiments on the effect of soil acidity on yield and quality of strawberries, potatoes, tomatoes, and corn have been undertaken. Studies were made also on the relation of soil

nitrogen to hydrogen-ion concentration. Because of the importance of iron in the diet, the possibility of increasing the iron content of green vegetables has been studied.

An experiment has been started to determine the effect of ammonium sulphate applied at different stages of growth, as compared with that of sodium nitrate, on the yield and composition of corn. In connection with this experiment, studies are being made on the quantity of available plant food removed from the soil in the immediate vicinity of the corn hills during thinning.

INVESTIGATION OF THE ODOROUS CONSTITUENTS OF THE COTTON PLANT

The results of the investigation to isolate and identify the odorous constituents of the cotton plant, undertaken in 1923 at the request of the Bureau of Entomology and completed this year, were communicated at a meeting of the National Academy of Sciences and subsequently published in the *Journal of the American Chemical Society* (vol. 47, pp. 1751 to 1774). As the cotton plant has a specific attraction for the boll weevil, it has been presumed that this was due to the emanation of some odorous substance which could be perceived by the insects at a considerable distance. It was thought that if any odorous substance could be identified, which by actual tests would be found attractive for the insects, it might be possible to produce it in sufficient quantities to permit of its use as a bait.

Among the numerous chemical substances found and identified in the distillate from the cotton plant, some of which had a fragrant odor, are ammonia and trimethylamine. These two basic substances were present in appreciable quantities in the distillate, but the ammonia largely predominated. Both were also found to be emanations from the living plant. Field tests have shown that trimethylamine possesses some attraction for the boll weevil, but much more extended experiments have still to be made by the entomologists in order to determine the practicability of its use as a bait under actual field conditions.

Large quantities of trimethylamine can be produced commercially at a comparatively low cost from waste sugar-beet molasses, for which some use has long been sought. Should trimethylamine prove to be an effective bait, this investigation may result not only in finding a means for reduc-

ing the great losses due to the deprecations of the boll weevil but also in providing a profitable outlet for a waste product of the beet-sugar factories.

PROTEIN RESEARCH

The nutritive value of the proteins in foodstuffs depends chiefly upon their content of the nutritionally essential amino acids. Proteins lacking in these amino acids are of little or no value for promoting the growth of young animals or for maintaining adult animals in a nutritively normal condition, when these proteins constitute the sole source of protein in the diet. Foods in which the protein is lacking in any of the essential amino acids should be supplemented with other protein foods which contain them. Progress was made in extending our knowledge of the composition of proteins from various sources. Little or no information on the percentage of cystine and tryptophane, which are essential amino acids, in the proteins of many of the most important foodstuffs was available. A paper on the tryptophane and cystine content of various proteins, based on extensive chemical research work in the bureau, gives for the first time the percentages of these amino acids in a large number of proteins.

A continuation of the studies on the proteins of wheat bran has shown that they differ in composition from those of the endosperm, which constitute the proteins of white flour. The bran proteins, in contrast to the wheat endosperm proteins, are characterized by having high percentages of the nutritionally essential amino acids. The bran albumin contains 4.76 per cent of tryptophane, the highest found in any plant protein hitherto reported; and the globulin is correspondingly high in the basic amino acids. These findings are of particular value, because the proteins of the wheat endosperm are deficient in these very amino acids. Approximately 22 per cent of the protein of the wheat kernel lies in the seed coats, or bran. This represents a vast quantity of protein in the total annual wheat crop. Feeding experiments to ascertain the availability to animals of the amino acids present are in progress. The results obtained thus far confirm the conclusions drawn from the chemical studies, that the bran proteins have a high food value. The value of wheat bran as a feed for animals has been long recognized by husbandrymen and practical feed-

ers of farm animals, but very little work has been done heretofore to determine the value of its proteins by carefully controlled scientific experiments.

It is planned to study the supplementary value of the bran proteins when fed with certain other proteins deficient in those amino acids which the bran contains in relatively large quantities.

Investigations previously reported have shown that the nutritive value of the proteins of the navy bean is limited by a form of indigestibility which can be remedied by cooking, and also that these proteins require the addition of cystine. Evidence obtained in the bureau goes to show that these proteins contain cystine in quantities which normally should be sufficient to meet the nutritional requirements of an animal for this amino acid. The defect of these proteins is then apparently not due to a deficiency of cystine but rather to a deficiency of *available* cystine. This may be explained by a possible combination between the cystine molecule in the protein with another amino acid or acids, which form a complex that is resistant to the action of the digestive enzymes. Feeding experiments to throw light on this question are in progress.

Notwithstanding the importance of rice as an article of human food, comparatively little work has been done on the rice proteins. During the year proteins were isolated from white rice—that is, rice from which the bran and germ have been removed—and from commercial rice bran, which contains both the bran and the germ, together with small quantities of endosperm. This bran contains nitrogen equivalent to 20.5 per cent protein. The various proteins which have been isolated are now being analyzed.

Progress has also been made in studies of the proteins of cottonseed, of timothy and orchard grass pollens, of sesame seed, of locust-tree bark, and of oysters, clams, and shrimp. Some physical constants of several proteins were determined.

VITAMINS IN FOODS

The extensive interest in vitamins, shown by the large number of letters asking for information on this subject, prompted the preparation of a pamphlet giving briefly and concisely information on the nature and properties of the five vitamins now generally recognized and the relative value of different foodstuffs as sources of vita-

mins. The effect of cooking and other processes used in the preparation of foods and of sunlight and irradiation upon vitamins is also discussed. The data thus presented have been compiled from the most recent sources of information. Hundreds of requests for the pamphlet have been received from all parts of the United States and also from foreign countries.

A paper on the effect of long-continued storage at low temperature on the vitamin A content of eggs gives the results of work completed on the subject. Modern improvements in industrial methods of preserving food products, such as refrigeration, dehydration, and canning have made it possible to keep foods in storage for relatively long periods. Many of our food products are subjected to such storage before they reach the consumer, and it is important to know what effect, if any, this treatment may have on their nutritive properties. The work described in this paper was undertaken to ascertain the effect of long-continued storage at low temperature on the vitamin A content of hens' eggs. The results of the feeding experiments show that no serious deterioration had taken place in the vitamin A content of eggs which had been held in storage in a frozen condition for nine years.

A paper on the vitamin A content of fresh eggs gives the relative vitamin A potency of egg-yolk oil and shows that eggs hold a very important place, if not the most important place, among the common food products as a source of vitamin A.

Work on the vitamin content of sugar-cane juice and of oysters, clams, and shrimps is under way.

SIRUP AND SUGAR INVESTIGATIONS

In response to the large number of requests for detailed information on the subject, a comprehensive bulletin on cane-sirup manufacture has been prepared for distribution during the 1925 sirup-making season. Owing to the desirability of extending the market for cane sirup, considerable attention has been given in the bulletin to a description of methods for producing sirup of uniform quality. The processes for making sirups of various types are also discussed, with a view to promoting the manufacture of the types best suited to different markets.

The bureau's work on sirup manufacture has been planned to give results of value to the entire industry. Inasmuch as the small sirup makers greatly outnumber the large pro-

ducers, the welfare of the small producer has hitherto been given particular attention. At the urgent request of Louisiana cane growers, however, an investigation has been undertaken recently for the purpose of developing an improved process for the production of better-quality sirup on a large scale. From an economic standpoint, some flexibility in the methods for utilizing a crop is frequently desirable. When the price of sugar is relatively low and the price of cane sirup high, as was the case in 1924, it is more profitable for cane growers to convert a portion of their crop into sirup. The method of making cane sirup now generally employed in Louisiana sirup factories, however, is that in which sulphur fumes and lime are used for clarifying the juice. This process gives the sirup a flavor which is very objectionable to many consumers.

A method for producing unsulphured sirup is therefore required in order to realize the greatest marketing possibilities. The work on clarification may also be expected to make possible eventually the production in Louisiana of a better-grade molasses as a by-product of sugar manufacture.

This work illustrates the application of chemical research and chemical technology to a practical problem, with the object of obtaining such flexibility in the manner of utilizing a crop as will permit better adaptation to changing economic conditions and markets, thereby yielding greater profit to the producer.

During the past year raw-sugar production has been investigated in Porto Rico. The longer manufacturing season there has made it possible to do more field work during the year, and the results obtained are directly applicable to the Louisiana cane-sugar industry. Certain reactions involved in the clarification of cane juice by liming, which is the customary factory treatment in commercial practice before crystallization of sugar, were studied. The control of this procedure is probably the most important single step in the recovery of sugar from cane juice. As a result of the experimental work, a method, based upon the determination of the hydrogen-ion concentration, and making possible more uniform control of liming, has been devised. A procedure has been developed whereby the liming of juice may be uniformly and automatically controlled by an electrometric method and a continuous recording potentiometer. This represents an important advance over existing practice.

Experiments were also conducted in Porto Rico on the efficient clarification in the factory of the juice from sugar cane of certain disease-resistant varieties. These results are of special value because of the prevalence of the mosaic disease of sugar cane in Louisiana and the steps that have been taken to introduce mosaic-resistant cane varieties there.

An investigation is in progress to determine the nature of the substances responsible for off-color cane and beet sugars and the manner in which these impurities are distributed in the crystals. Information of much value has been obtained, pointing to means which may be taken to reduce this trouble.

A study of the nature of the substances which accumulate during the Steffen process for desugarizing beet molasses and of the manner in which these substances cut down sugar yields is nearing completion. This investigation has involved a comparison with respect to viscosity and sugar solubility between molasses resulting from the Steffen process and molasses produced in factories which do not use a desugarization process. These results will be of value in connection with efforts to increase the yield of sugar from sugar beets, thereby increasing the value of an important crop.

Because of the importance of the plant colloids which are present in cane and beet juices and which play a large part in determining the yield and grade of sugar obtained, the study of these plant colloids has been continued. A number of practical testing methods, which will greatly facilitate the investigation of this subject, have been developed. Under the present status of scientific knowledge, the investigation of the colloids in the juice is the most promising line of work now available for developing improved methods to increase yields of sugar from sugar-producing plants.

A study was made of the substances which lower the quality of molasses, a valuable by-product, especially in white-sugar manufacture. These substances are largely colloidal and are responsible in a great degree for dark color and objectionable flavor. In edible molasses particularly, an improvement of the grade by the elimination of certain impurities will make a decided difference in the total financial return from growing sugar cane. The results obtained so far promise to assist greatly in devising measures to limit the production of inferior molasses.

Methods for determining hydrogen-concentration have been investigated for the purpose of developing an improved procedure for controlling the clarification of beet juice in the carbonation process.

Several scientific and semipopular articles describing the results of the year's work on sirup and sugar have been published.

FRUIT AND VEGETABLE UTILIZATION

The more profitable utilization of fruits and vegetables through the development of new or improved technical methods for manufacturing commercial commodities from surplus crops and culls continues to be from year to year one of the most effective ways in which the science of chemistry can serve the agricultural and manufacturing industries of the country.

The utilization of large quantities of what would have otherwise been waste oranges and lemons was continued in factories in California through the use of methods worked out in collaboration with the laboratory of this bureau established in Los Angeles for the purpose. One plant operated by citrus growers manufactured last year approximately 2,000,000 pounds of citric acid, using about 40,000 tons of cull lemons, which returned to the growers an average of \$12 per ton, with a total net return of about \$450,000. The net gain to the growers, however, was really larger than this, as heretofore the cull lemons were a liability on their hands, which had to be disposed of at a cost of at least \$1 per ton. In addition to citric acid, there are manufactured lemon juice, lemon oil, and pectin. Last year about 65,000 pounds of lemon oil, with a value of approximately \$70,000, together with 30,000 pounds of pectin, was produced at one plant.

From waste oranges are manufactured juice, marmalade, pectin, orange oil, and other products. One plant, which used last year 10,000 tons of oranges, put out, among other products, about 50,000 pounds of orange oil having a wholesale value of approximately \$100,000. One concern has even found a profitable outlet for orange pulp.

The disposal of orange pulp from which the juice had been extracted was once a distinct problem, costing about \$800 a month. A method was found for the preparation and disposal of orange pulp as feed for dairy cows, and now the profits from this source amount to from \$2,500 to \$3,000

a month. The average price last year for the wet pulp, containing 85 per cent of moisture, was \$3 per ton.

The preparation of several lots of pomegranate juice, undertaken for the pomegranate growers, has resulted in one or two projects for the utilization of surplus crops. The success or failure of these projects will be largely a matter of financing and business management. The surplus fruit is cheap and readily obtainable and the method of the preparation of the juice is satisfactory and inexpensive. Experiments on the production of pomegranate sirup and pomegranate concentrate are planned.

During the year a bulletin on the production of citrus pectin was issued and Department Circular 232, "By-Products from Citrus Fruits," was revised.

The proper standardization of various fruits depends upon practical methods for determining maturity and upon the extent of injury from frost, sunburn, molds, and the like. These can not be determined by observation alone. Progress was made in solving the problems involved in the standardization of raisins, and this work was discontinued at the end of the year. Laboratory work was done to find tests for sunburn and molds. Satisfactory stains were not found. A test depending upon the catalase activity of mold promises to solve the problem so far as mold is concerned. If raisins are placed in hydrogen peroxide, moldy fruits will at once begin to decompose the reagent, with an immediate evolution of oxygen. A little gas is produced along the stems of normal raisins, probably from the catalase of yeasts or molds fastened to them, but this evolution of gas is easily distinguished from that of moldy raisins.

As the result of cooperative laboratory work with the Bureau of Chemistry, the Raisin Growers' Association developed a device whereby raisins are stemmed, the stems and trash are separated by an air current, and the stemmed berries are collected in a can of definite volume. This can is mechanically shaken while the raisins are flowing into it, and when full it is weighed. The raisins vary in weight according to their grade. The apparatus also affords a means of weighing sand and trash mixed with the fruit. A device by which the approximate moisture content of raisins can be estimated in a few minutes has been designed. This is of no little importance to raisin buyers.

Department Bulletin 1250, "The Relation Between the Composition of California Cantaloupes and Their Commercial Maturity," published during the year, outlines the work done to develop maturity standards for cantaloupes and gives the tests for determining maturity. The soluble-solids test described is now applied commercially in determining when to pick cantaloupes for the market. The solids content of the juice of good melons is decidedly greater than that of the juice of less desirable melons. A test based on solids or specific gravity has the advantage of being practical for field operations, as it is easily made and does not require expensive apparatus. A Brix spindle reading, which gives the soluble solids, can be used as a measure of quality and maturity in cantaloupes, and suitable limits are suggested in the bulletin. The value of a proper test for the maturity for cantaloupes lies in the difficulty of placing California melons in eastern markets in a satisfactory condition unless they are picked at the right stage of maturity. If allowed to become too nearly ripe before being picked they will not keep in good condition until they reach consumers. If, on the other hand, they are picked too soon the flesh becomes shriveled and tough, and the melons lack color and odor and are disappointing in flavor.

One of the horticultural commissioners in a cantaloupe-producing section of California recently stated that "the establishment of the soluble-solids test for determining the maturity of cantaloupes has practically revolutionized the cantaloupe industry, and has been of inestimable value to the growers. Before this method was established the different interstate markets were demoralized by the continuous shipment of green cantaloupes, but this system has eliminated all question as to the maturity of our produce and has proved very economical and practical."

Likewise the maturity standard for oranges, mentioned in previous reports, has been practically applied in the picking of oranges, with great benefit to growers, shippers, and consumers. The standards for both oranges and cantaloupes as worked out in the Bureau of Chemistry have been made a part of the laws of California.

Requests for additional work on maturity tests have been received from associations of avocado, pomegranate, peach, and plum growers.

Progress was made during the year in a study designed to develop prac-

tical methods for detecting frosted oranges and lemons and for determining the extent of frost injury and how to utilize most profitably the fruit which in varying degrees has been injured. The result of this work, it is believed, will reduce materially the enormous losses that sometimes occur from the freezing of oranges and lemons.

In collaboration with the Bureau of Plant Industry, work has been continued in identifying citrus fruit of different strains by chemical means. This whole project is of great value to citrus growers as a means of improving both the quantity and quality of their fruit. It has already been shown that certain selected strains of lemons and oranges differ in chemical composition, and there is reason to believe that other strains may show like variations. A wide field of investigation which may yield important data on other fruits has thus been opened.

Investigations looking to improvements in the methods for the manufacture of sauerkraut and pickles were continued. Instructions for bringing pimentos and for pickling chayotes were issued. Information on standardization in sauerkraut production was furnished the Sauerkraut Packers' Association and the standards suggested were accepted by the association and also made the basis for a sauerkraut standard to guide food officials in the enforcement of food laws. Work was started on a bulletin dealing with the commercial production of sauerkraut.

Five editions of Farmers' Bulletin 1438, "Making Fermented Pickles," were issued. A second edition of the bulletin on how to make vinegar in the home and on the farm was printed.

Department Bulletin 1335, "Commercial Dehydration of Fruits and Vegetables," completed this year, gives the results of an investigation on improved methods for dehydrating various fruits and vegetables begun in 1918 and terminated last year. This work shows that when proper methods are used dehydrated products of superior quality can be made. Some of the fruits and vegetables upon which experimental work was done can be dehydrated in such a manner that practically all the flavor and color of the fresh product is retained.

COMPOSITION OF VEGETABLE OILS

Chemical researches to extend existing knowledge of the composition of vegetable oils, in order that they may be the more profitably utilized,

were continued. This work requires extended and painstaking laboratory experimentation in order that all the complex substances that make up the vegetable oils and their properties may be determined. At the present time the development of the vegetable-oil industry is retarded because of a lack of knowledge of the exact composition of many of the vegetable oils and of methods for isolating some of the constituents which have a marked effect on the economic utilization of the oils.

Further progress was made in an investigation of the constituents other than the glycerides of cottonseed oil. A so-called vegetable mucilage has been separated from the crude oil and found to be identical with that extracted from the cottonseed. The vegetable resin previously detected was separated and further studied. This was found to have some emulsifying power, which, however, was not nearly so great as that of the mucilage. Another constituent has been isolated from the settlings obtained when the crude oil is allowed to stand some time. It constituted about a third of these particular settlings. It has been found to be a high-melting glyceride, but its composition remains to be determined.

Further investigation of the action of direct sunlight on various oils has shown that, after exposure to direct sunlight, their unsaturated acids, freed from phytosterols, apparently affect photograph plates to the same extent as when mixed with the phytosterols. Much interest has been shown in this investigation by those engaged in studying the deterioration of paint films. Some of these investigators are applying and extending this study to meet their particular problems.

A study of the keeping quality of crude oils in contact with foots, as compared with the keeping quality of those freed from foots immediately after expression, is in progress. Some evidence has already been obtained that crude oils in contact with foots when stored in the dark, as is the practice at crude-oil mills, deteriorate more than those freed from foots, and also that portions of the same oils exposed to diffused light deteriorate much less in the same time. This work will be continued for another year in order to obtain complete data. Many refiners believe that thousands of dollars have been lost through inefficient handling of crude oils at the mills.

Manufacturers of refined corn oil are having difficulties in making a product that will remain clear, the corn oil after a time becoming slightly turbid. The cause of this turbidity was not known and the nature of the substance causing it has been a matter of controversy. The bureau has shown that the turbidity is due to a true wax, not to stearin or other substances as has been claimed. The nature of the wax will be studied further. Some corn-oil refiners have already succeeded in separating the wax from the oil.

The composition and chemical characteristics of authentic samples of California and Italian olive oils have been determined. This work has shown that olive oil contains notable quantities of stearic acid, thus settling a long-standing controversy regarding the absence or presence of stearic acid in olive oil. The Italian olive oil examined contains more than 1 per cent more of oleic acid and about 2 per cent more of saturated acids as glycerides than the California oil. This is the first time that the composition of olive oil has been investigated by modern methods.

INSECTICIDE INVESTIGATIONS

The bureau investigates chemical problems relating to the composition, manufacture, action, and application of insecticides and fungicides, with the object of developing better and cheaper chemical compounds for the more effective control of fungi and insects in order to reduce the enormous losses that occur in the growing of crops from these causes. This work is carried on largely in cooperation with the Bureaus of Entomology and Plant Industry.

Experimental work has developed as a substitute for carbon disulphide a grain fumigant which is free from the fire hazard. The necessity for this substitute arose from the fact that carbon disulphide is highly inflammable, making its use in box cars and elevators exceedingly dangerous. Fire insurance companies refuse to carry the risk on elevators, bins, and other property while it is being employed, and the railroads have prohibited its use for fumigating cars loaded with grain except at two designated isolated points. The cooperative work by the Bureaus of Chemistry and Entomology showed that a mixture of ethyl acetate and carbon tetrachloride is effective in killing destructive weevils in wheat in box

cars, grain elevators, and other tight inclosures. This fumigant is non-inflammable at fumigation temperatures, is noninjurious to those handling it, does not lower the germinating quality of seeds, does not injure the baking quality of flour from fumigated wheat, and costs less than 1 cent per bushel of fumigated wheat. It can be used effectively on wheat in elevators as well as in box cars.

In view of the rapid extension of fumigation with hydrocyanic acid to destroy insect pests, an investigation has been made in cooperation with the Federal Horticultural Board and the Bureau of Entomology to learn whether or not certain products so fumigated are rendered unfit for human consumption. The results, published in Department Bulletin No. 1307, show the quantities of hydrocyanic acid absorbed and retained by fumigated dried fruits, candy and candy-making materials, and cereals, meat, cheese, and dried milk, as well as the effect of storage and cooking on the hydrocyanic acid content.

A method for the rapid examination of foliage for spray residues from lead arsenate, developed in cooperation with the Maryland Agricultural Experiment Station, was published. This is of value in furnishing investigators with a rapid, easy, and sufficiently accurate method for studying the distribution of sprays and dusts and the efficiency of spreaders and stickers, and also for studying the effects of rain and other weather conditions on the retention of insecticides on foliage and the relation of the quantity of arsenic present to leaf injury.

A study on the mineral oil emulsions used as insecticides, now under way, is designed to determine the conditions under which emulsions may be prepared and the conditions which influence their stability. The results of an investigation into the cause of the sluggish reaction noted by manufacturers in the oxidation of white arsenic were published. The deterioration of nicotine dusts and of nicotine soap preparations used as insecticides has been investigated and the results have been published. A paper on the chemistry of dry lime-sulphur, barium sulphur compounds, and sodium sulphur compounds will soon be published in a joint bulletin by the Bureau of Chemistry and the Bureau of Entomology on the effectiveness of these sprays.

A systematic study of the effect of varying conditions, such as temperature, concentration, and time of di-

gestion, in the manufacture of calcium arsenate, which is extensively used as an insecticide, has been in progress during the year in order to discover why commercial calcium arsenate of the usual acceptable standard sometimes injures foliage. The development of a method for determining free calcium hydroxide in commercial calcium arsenate, published during the year, has been of great service in interpreting the results of this investigation.

A paper describing the preparation and properties of 16 arsenates of calcium, several of which are new, will be published at an early date. Not only will this information be of scientific value but it will give a better understanding of commercial arsenates of calcium and make possible their preparation in quantities large enough to permit a study of their relative values as insecticides.

PLANT-DUST EXPLOSIONS AND FIRES

The prevention of dust explosions and resultant fires in industrial plants is commanding the attention of investigators in every country in the world where manufacturing operations are carried on. The losses of life, foodstuffs, and property as a result of these dust explosions have indicated a need for the determination of their causes and the development of effective control measures.

The research work of the Bureau of Chemistry has been practically confined to the dust-explosion hazards in the grain-handling industry, which have caused extensive losses of life and property. It has not been possible to study the dust explosions in industries of all types. Records of approximately 270 dust explosions in plants in the United States and foreign countries have been obtained. In 66 of these explosions 444 lives were lost, and in 83 of them 780 people were injured. The total money loss in 132 explosions approximated \$32,917,000, an average of more than \$250,000 for every explosion. The Bureau of Chemistry is conducting special research investigations to determine the causes of these explosions and the circumstances favorable to their origin.

More than 21,000 establishments in various industries in the United States, manufacturing products with an annual value in excess of \$6,779,449,000, are subject to the dust-explosion hazard. The bureau investigations have shown also that extensive losses have been experienced from

dust explosions and fires in grain-threshing machines, particularly in the Pacific Northwest, and from cotton-gin fires in the Southwest.

Special studies have been made to determine the practical possibility of installing effective dust-collecting systems for the control of explosive dust created in the handling and storing of grain in terminal grain elevators. This work involved special engineering investigations to determine the points of suction application, type and design of hoods, apparent effect on grain weights, and other factors related to the weight readjustment of existing commercial practices.

Tests were conducted at a number of elevators in the East and Middle West, and many data, to be used in designing dust-collecting systems of this character, have been gathered. A bulletin, now in course of publication, gives the results of these investigations, together with recommendations for the installation of dust-control equipment for grain elevators. The bureau's work on this project was done in cooperation with a number of industrial agencies, such as the Terminal Elevator Grain Merchants Association, the National Fire Protection Association, and the Underwriters' Laboratories.

The encouraging laboratory results already obtained by the bureau indicated that the dust-explosion hazard during grinding operations can be practically eliminated by the use of inert gases. During the past fiscal year the activities on this project have consisted principally in the development of a large-scale testing unit at the Experimental Farm, at Arlington, which includes grinding, conveying, and elevating equipment similar to that used in operating practices. Carbon dioxide obtained from boiler flue gas, which is to be used as the inert gas, will be introduced into the grinding apparatus under actual operating conditions. It is hoped that this work will furnish enough additional data to enable the bureau engineers to design equipment practicable for industrial use. The dust-explosion losses from grinding grain and similar materials have been very great, resulting in extensive losses of life and property.

Static electricity, which has caused a great many dust explosions, may be generated in a number of ways. Methods for its elimination in industrial plants and in grain-threshing machinery have been considered in the bureau. Electrically grounded metallic combs, recommended for removing static

charges from belts, are not entirely satisfactory. The ground wire may be broken, thus increasing the hazard, and the combs are detrimental to the belt. Metallic combs can not remove induced charges from insulated substances. A Government-designed waterproof conducting belt coating, free from stickiness and of good wearing quality, which may be used without hindering the action of either belt or pulley, has proved thoroughly efficient in removing the charges of static electricity.

A study of the effect of prolonged heating on the ignition temperatures of several dusts has produced a more accurate method for the measurement of ignition temperatures. A preliminary survey was made to obtain data on the probable application of hot journal alarm systems, to be used in connection with a study of overheated bearings and their relation to fire and explosion. During the year 6 explosions were investigated—2 in flour-milling plants, 1 in a stock food plant, 1 in a grain elevator, 1 in a paper factory, and 1 in an aluminum factory.

Cooperation was continued with insurance underwriters, State commissions, and fire-prevention agencies in the application of measures for the prevention of cotton-gin fires. Department Circular 271, describing a new wiring system for grounding cotton gins, has been sent out to a large number of cotton ginneries.

The bureau cooperated with the State fire marshal of Washington, with manufacturers of threshing machines, and with underwriters in the application of control measures for preventing explosions in threshers. The insurance rates on threshing machines equipped in accordance with bureau recommendations have been reduced.

The losses from thresher explosions and fires have been greatly reduced as a result of the work of the Bureau of Chemistry.

COLOR EXPERIMENTAL WORK

American manufacturers now produce vat dyes of brilliant color and lasting quality, as the result of processes developed by American chemists for making cheaply and of remarkable purity two dye intermediates formerly obtainable only in Germany. The process for making one of these essential intermediates, phthalic anhydride, worked out in the bureau, has been outlined in previous reports of the chemist. The vat dyes, because they are fast and durable, are especially

adapted for cotton goods, and their use is being rapidly increased. In 1914 no vat dyes were manufactured in the United States and 1,945,304 pounds were imported. In 1923 American manufacturers in the United States put out 1,766,383 pounds of vat dyes, and the country imported 1,207,554 pounds. In 1924 there was produced in this country 1,821,319 pounds, as against imports of 1,499,322 pounds. These statistics do not include indigo, which is also a vat dye.

All the phthalic anhydride now manufactured in the United States is made by the Bureau of Chemistry process. This essential intermediate has been sold in Europe, because both of its comparatively low cost and its exceptionally high purity. Approximately 2,300,000 pounds of phthalic anhydride was produced in this country in 1923, the last year for which statistics are available. The average price of phthalic anhydride manufactured in America has been about 29 cents per pound, and prices as low as 16 cents per pound have been quoted. Before the war the price of the product made in Germany was approximately 30 cents per pound, which to-day would be equivalent to about 53 cents. The product made by the American process is not only relatively lower in cost, it is also higher in purity.

In a recent article in a technical journal the chairman of the dye division of the American Chemical Society made the following statement regarding the contribution of this bureau to the development of the manufacture of vat dyes:

Thus we see that the manufacturers of vat dyes now have at their disposal cheap and pure products with which to build up the complex molecules characteristic of these coloring matters which give the brightest shades and the most permanent colors yet made. Every one knows that the permanency of color is an important item in every household. Who has forgotten the rapidly fading colors of 1916 and 1917? Who does not know the waste that these poor colors entailed in replacement costs for clothes and draperies? Who is not now familiar with the sunfast, no-fade clothes and materials? These are possible because of the vat dyes, and the American vat dyes are with us because of the development of cheap aluminum chloride and phthalic anhydride. And the latter is cheap because of the work of two chemists in the color laboratory of the Bureau of Chemistry of the Department of Agriculture. Thus, if one were inclined, it would be possible to figure out the saving to himself, to each family, to the Nation as a whole, brought about as the result of the work of the color laboratory, which was organized to help establish American independence in dyes. Not only has it done that, but, as shown above, it has caused a material saving and increased economy to each and every person who uses any cotton cloths—and who does not?

The total production of coal-tar dyes in the United States in 1924 was 68,679,000 pounds, which is a decline from the maximum output in 1923, due principally to decreased activity in the textile industry. The pre-war output of 1914 was only 6,619,729 pounds. Dyes of domestic manufacture now supply about 95 per cent of the consumption in the United States, and there was in 1924 an exportable surplus of certain dyes amounting to 16,000,000 pounds, according to reports by the United States Tariff Commission.

During the year progress was made in the work on the dyes used as biological stains by bacteriologists, biologists, physicians, and others engaged in health work to identify the microorganisms that produce disease. Without stains of known composition disease-producing bacteria can not certainly be identified. Before the war these stains could be obtained only from Germany. The work under way in the bureau is designed to gather all available data on the dyes used for this purpose and to develop specifications or standards for their manufacture to make it possible to insure the production of suitable dyes for staining. Because the volume of the business is small, commercial concerns can not well afford the basic research necessary to develop this phase of dye chemistry. Yet its development is essential in a country which aims to establish a complete dye industry and to be independent of foreign countries in this important field.

Work on the vapor-phase sulphonation of naphthalene has been completed. The chemistry of the process has been worked out and published. The problem now is merely one of mechanical construction for the best results. Progress was made in the study of hydrolysis of the sulphonic acids of naphthalene. The data from this study will aid in the production of the isomeric acids and possibly indicate new methods of isolation and purification. Means of establishing the identity of the methyl violet group of dyes have been worked out. The increasing use of members of this group in therapeutics makes this work of value also from the standpoint of medicine. In cooperation with the National Research Council, vapor pressures of the isomeric nitroanilines and of the mono- and di-methyl and ethyl anilines have been determined. It was found that all the nitroanilines decompose on heating at atmospheric pressure before they boil. This work

will be pursued with other intermediates, thus obtaining further data of importance in manufacturing processes.

CERTIFICATION OF FOOD COLORS

The growth of the certification of food colors has been rapid during the past year. This apparently is due not to any material increase in the use of food colors but to the fact that a larger proportion of the colors used in food are certified. Food manufacturers are coming more and more to demand that the dyes furnished them be certified. Only dyes that are known to be harmless and meet the required standard of purity are certified. During the year food colors were certified by 34 concerns, 9 of these being new certifiers. Eight batches of straight dyes and one batch of mixture were rejected. The work of passing on these dyes has been so systematized that notwithstanding a more than 18 per cent increase over the previous year, certification has been made, as a rule, in a shorter time than formerly. Table 1 indicates the quantity of dyes certified during the past three years.

TABLE 1.—*Coal-tar food dyes certified, 1923-1925*

	1923	1924	1925
Straight dyes (pounds).....	250,756	232,305	315,848
Repacks (pounds).....	20,216	26,956	39,013
Mixtures (pounds).....	239,614	281,148	284,060
Total batches examined.....	633	724	883
Firms.....	27	30	34
New firms.....	4	6	9

LEATHER, PAPER, AND FABRIC TECHNOLOGY

LEATHER AND TANNING MATERIALS

Raw materials for leather making are primarily agricultural products, and of the users of finished leather articles (harnesses, belts, shoes, boots, and the like) those engaged in agriculture form the largest class. Because of this dual relationship between the leather industry and agriculture, from the standpoints both of production of raw material and consumption of finished products, the Department of Agriculture naturally finds among its problems those of the leather industry. Long realizing that the domestic supplies of leather-making raw ma-

terials are inadequate and likely to be less plentiful in the future, the bureau has emphasized the importance of a conservative utilization of these materials, of making better leather, and of giving proper care to leather goods, which cost the people almost \$2,000,000,000 annually.

Recent investigations on the distribution of tannin in the American chestnut tree have shown that stumpwood, root wood, and root bark are relatively rich in tannin, some samples of root bark containing more than 30 per cent tannin and some of root wood more than 20 per cent. The usual chestnut wood of commerce has only from 7 to 9 per cent of tannin. It was also found that the edge zone of the heartwood is much richer in tannin than the central zone.

Aside from their scientific interest, these findings suggest consideration of the use of chestnut stumps and roots as a commercial source of tannin extract and indicate that from a given lot of chestnut timber a higher yield of tannin would be obtained from slabs than from the rest of the wood.

In attempting to find possible new sources of tannin, numerous plant products have been analyzed. Among these bear clover (*Chamaebatia foliolosa*) was found to contain from 12 to 14 per cent of tannin. This shrub grows extensively over the Sierra Nevada mountains, where it is a fire menace. Data so far obtained on its tannin content and certain other factors regarding its growth and harvesting justify a further preliminary study of this material as a possible commercial source of tannin.

Pest and disease attacks upon cattle often result in a damaged hide for leather making. Tick marks and grubworm holes are well-known results. More recently several instances of defective leather from another cause, apparently unrecognized by the tanner, have been submitted to the department. The bureau, in cooperation with the Bureau of Animal Industry, has shown that this imperfection is the result of follicular mange contracted by the animal during life. This mange, although known for many years to exist among cattle, has not been considered sufficiently common to deserve attention. From recently submitted evidence and from data now being collected, however, it seems to be becoming more widespread and more serious to the leather industry than is generally appreciated. It deserves recognition as a real menace to our domestic supply of hides and skins.

In cooperation with the authorities handling the Alaskan fur-seal kill, a number of suggestions on handling and curing these skins were offered by the bureau. These suggestions, which were radical departures from existing practices, were put into effect with marked success and have now been adopted.

Educational work has been continued on the proper methods for skinning, curing, and marketing domestic hides and skins for leather making. Farmers' Bulletin 1055, "Country Hides and Skins," which was issued several years ago and has received the hearty indorsement of the leather industry, was recently selected by the Inter-American High Commission for translation into Spanish and distribution in South America.

In the South and Southwest the skins of goats and kids which are raised for family use are seldom marketed. Experiments are being conducted to develop methods for tanning these skins at home and through the aid of the department's demonstration agents to work up the resulting leather into small fancy leather articles, the sale of which should bring a good return.

A third reprint of Farmers' Bulletin 1183, "The Care of Leather," has been exhausted. Because of the widespread demand for the information in this publication, particularly that dealing with shoes, the subject matter has been divided. Two bulletins will be issued during the next fiscal year—one on the care of shoes and the other on the care of harness, belting, and other leather goods.

Recent developments in studies of the deterioration of leather have shown that leather bookbindings may deteriorate because of the corrosive action of the polluted atmosphere of large cities and other industrial centers, as well as from other causes already well recognized. The effect of different degrees of exposure to the atmosphere has been shown very strikingly by comparative analyses of various parts of bindings. The results of this work are being assembled and prepared for publication. By following up the lead furnished by these findings it may be possible to develop a treatment that will double or treble the life of leather bindings.

PAPER INVESTIGATIONS

The study of the physical properties of paper used for wrapping fruits and vegetables was continued. A large number of fruit-wrapping papers were

collected from citrus-fruit packers and shippers in Florida. Some of these papers are reported to lack the strength necessary to withstand service conditions. All the samples collected in Florida have been tested. The data on them, together with the results of tests previously made on many samples collected in various parts of the country, have been compiled. It is now possible to state definitely what physical properties papers for this purpose should possess in order to withstand service conditions. The results of this investigation, soon to be published, will aid packers and shippers to specify paper that will answer every purpose of a satisfactory fruit-wrapping paper and to purchase such paper at the lowest practical cost.

Undeveloped coated brown-print paper, used extensively in engineering and construction work for preparing negatives from original drawings on tracing cloth, deteriorates in strength very rapidly when stored under ordinary conditions. An investigation to determine to what extent the deteriorating effect on the paper of the commonly employed brown-print sensitizing materials is affected by temperature, and to determine under what temperature conditions the undeveloped coated paper may be preserved longest was completed. The results, which have been published, show that the undeveloped coated paper can be kept at 35° to 40° F. for at least five months without any deterioration in strength.

Progress was made during the year in the work to determine what physical properties map paper should have to withstand the rough handling to which it is sometimes subjected, to determine the relative value of carbon paper of different weights and kinds, and to determine the effect of temperature and humidity on the physical properties of paper. Work was done also on the preparation of specifications for paper for various uses in the Government service.

WATERPROOFING AND PRESERVING FARM FABRICS

Work on methods for preserving tobacco shade cloth was continued. Experimental work was done on the waterproofing of old weathered canvas not previously treated, on waterproof dressings for old automobile tops, and on fireproofing treatments. Information on these subjects, together with data on the protective effect of pigments against injury by sunlight and new waterproofing form-

ulas, are being incorporated in a revision of Farmers' Bulletin 1157.

IMPROVING THE PRODUCTION OF ROSIN AND TURPENTINE

Investigations on the production and properties and on the weighing, handling, grading, and uses of rosin and turpentine continued from previous years included work on the preparation and distribution of glass standards for rosin and of color standards for turpentine. Substantial progress was made in demonstrating new and improved processes for producing rosin and turpentine. Work was done on a new method for detecting steam-distilled wood turpentine in gum spirits of turpentine. The detection of mineral spirits by odor was investigated.

Attention was given to the trouble that varnish makers have had with certain rosins which tend to crystallize. Advice on how to overcome the difficulties has been given, but the exact cause of the tendency to crystallize, which seems to be most prevalent in rosin of the higher grades, has not yet been learned.

The color values of a large number of samples of wood rosin as regularly produced at southern wood-distillation plants have been determined. This rosin has a brilliant ruby red color entirely distinct from the color of ordinary gum rosin. This difference in color composition makes it difficult to grade wood rosin by the established standards. Under the standards set by the naval stores act all commercial wood rosin now being made must be graded as "D" or "E," not as "F," which was the grade usually assigned before the passage of the act. This new designation is not an indication that the quality of wood rosin has been lowered; it is simply the correct classification, under the naval stores act, of wood rosin as made for the past 15 years.

Preliminary studies of various coatings for the interior of sheet-iron drums have been made. Silicate of soda, or preferably a mixture of silicate and whiting, which will show when the entire surface has been covered, proved to be efficient in protecting the rosin from dissolving rust. Whitewash gave less protection than the silicate of soda; whiting alone gave no protection.

Color readings have been made on standard-type samples of very light-grade French rosin as a preliminary step toward establishing a standard

in this country for rosin of lighter color and higher grade than "X," the present top grade. It is believed that when certain improvements in production along the line of methods used in France are perfected and in general use, extra high-grade rosin will be made in this country to a much greater extent than at present.

The educational work among naval stores producers to explain and demonstrate new and improved methods, processes, equipment, plant layout, and construction in the manufacture of rosin and turpentine was carried on during the year with a large measure of success. The benefits from the use of the recording thermometer in operating a turpentine still were demonstrated, and as a result the number of installations of recording thermometers has greatly increased. The design and the method of installing recording thermometers on turpentine stills were improved, making the thermometers more sensitive and the temperature readings more accurate. Experiments were conducted at a number of stills to determine a better method of distilling scrape, the semi-hard, white, resinous material which accumulates on the chipped face of a turpentine tree. It was found that under well-regulated control of the still, with proper handling, an average yield of about 5 gallons of turpentine from each 300-pound barrel of scrape may be expected, and that 5 round barrels of rosin to each 50 gallons of turpentine obtained is an average yield.

Increased interest among operators in the methods of grading rosin and gauging turpentine was aroused. A number of disputes on grading and gauging between producers and buyers were settled. Mimeographed monographs on charging and discharging turpentine stills, on thermometers for stills, and on the operation of stills with and without recording thermometers were prepared and sent to all naval stores producers.

THE DEVELOPMENT OF METHODS OF ANALYSIS

The development of methods of analysis for the advancement of agricultural chemistry and of the chemistry of related industries has for many years been one of the important lines of work. This work can be done most economically and efficiently in co-operation with the scientific associations which are concerned with the science of chemistry. Chief among these cooperating bodies, in so far as

the work of this bureau is concerned, is the Association of Official Agricultural Chemists.

The objects of the Association of Official Agricultural Chemists, which is now 41 years old, are: (1) To insure uniformity and accuracy in the methods, results, and modes of statement of analysis of fertilizers, soils, cattle foods, dairy products, human foods, medicinal plants, drugs, and other materials connected with agricultural industry; (2) to afford opportunity for the discussion of matters of interest to agricultural chemists. The association is of limited international character in that its active membership includes analytical chemists connected with official institutions in the United States and Canada, engaged either in research work in agriculture or in the enforcement of laws applying to any of the products covered by the work of the association.

The methods of analysis of the association have long been recognized as the best available in the fields of activity occupying the attention of the association. They are widely used by agricultural, industrial, and research chemists. In control work the use of the association's methods is often mandatory.

From 1884 to 1894 the methods of analysis adopted by the association, together with the proceedings of the annual meetings, were published each year as a bulletin of the Division of Chemistry of this department. In 1895 the methods, brought up to date to include the changes sanctioned by the 1895 meeting, were printed as Division of Chemistry Bulletin 46. This bulletin was later revised to incorporate the changes subsequently made at the annual meetings up to 1899. The provisional methods for the analysis of foods, authorized by the 1901 meeting, were issued in 1902 as Bureau of Chemistry Bulletin 65. In 1907 the official and provisional methods as adopted by the association up to that time were printed as Bureau of Chemistry Bulletin 107, which was revised in 1908. A reprint of this revision was made in 1912. The methods were of such importance to the Bureau of Chemistry that from 1903 until 1912 circulars giving the official changes in the methods were issued as soon as possible after each annual meeting.

In 1920 the association itself published these methods of analysis, revised to November 1, 1919, in book form, under the title "Official and Tentative Methods of Analysis of the Association of Official Agricultural

Chemists," and during the present fiscal year the second, or 1925, edition of this book, containing the methods revised to July 1, 1924, has been issued. Various members of the bureau have taken an active part in this latest revision of the methods of analysis of the association and in other features of the association's work during the year.

WORK FOR OTHER DEPARTMENTS

The Bureau of Chemistry is called upon to do a great variety and a large volume of chemical work for other departments of the Federal Government. This work varies from an extended investigation for the Post Office Department, to determine whether or not a medicinal product will fulfill the claims of its promoter in relieving or curing certain diseases, to making a complete chemical analysis of a sample of food for the War Department to determine whether or not it is wholesome and meets the specifications under which purchased. Representatives of other departments frequently consult the specialists of the bureau regarding chemical problems that arise in their work. These consultations, which may be by correspondence, by telephone, or by personal interview, during a single year cover different phases of nearly every subject upon which the bureau works. The specialists of the bureau are frequently in a position to furnish other departments immediately with information which has a direct bearing on their problems and which could otherwise be obtained only at considerable cost for extended laboratory experimentation or original research.

As a result of the cooperative work with the Post Office Department designed to prevent the use of the mails for fraudulent purposes in the sale of medicinal preparations, fraud orders were issued by that department against eight concerns during 1925. The various preparations on which the fraud orders were based were sold as remedies or cures for a host of ills, including tuberculosis, diabetes, rheumatism, piles, impaired eyesight, catarrh, asthma, dropsy, anemia, nervousness, syphilis, impotence, Bright's disease, bladder weakness, prostatitis, hardening of the arteries, high blood pressure, varicocele, eczema, paralysis, and liver and kidney disorders. Some six other cases were closed when the concerns involved made affidavits to discontinue their use of the mails for the sale of their products. Other cases were closed either after court

contests or by agreement to discontinue the business. The necessary chemical and medical evidence was furnished in all these cases by the Bureau of Chemistry. Some of the cases involved extended investigations in order to develop the evidence necessary to prove the fraudulence of the practices involved.

Members of the technical staff of the bureau served on committees of the Federal Specifications Board and assisted in the preparation of specifications for the purchase of various products used by the Federal Government. Besides assisting in the preparation of specifications for the purchase of foods, drugs, stock feeds, chemicals, chemical apparatus, insecticides, leather and leather articles, paper and paper articles, and the like, the various laboratories of the bureau examined numerous samples of these products upon the requests of other departments to see that the products delivered by the contractors complied with the specifications under which they were purchased. Technical assistance was also rendered the General Supply Committee in determining the relative value of various articles submitted by bidders for contract supplies and also in examining samples taken from shipments of supplies delivered to the Government on contracts to see that they came up to the specifications and to the sample originally submitted with the bid. This work is confined to products on which members of the staff of the bureau specialize.

At the request of the Post Office Department, specifications were prepared for pocket-size commission cases for the use of post-office inspectors. The cases previously used have failed in a short time. The bureau's examinations showed them to be defective in construction.

At the request of the Chief Coordinator of the Federal Government, an investigation was made to determine the effect of storage for several years on the physical properties of certain wrapping papers. In acknowledging the report of this investigation, which involved the examination of about 50 samples, the chief coordinator said:

I wish to thank you for the complete and exhaustive tests you have made on the paper samples. The information contained in your report has been of material assistance in the handling of a problem which, without such information, would have been extremely difficult of solution. I can not, therefore, express too highly my appreciation of your cooperation and helpfulness and of the important service rendered in the interest of Federal economy.

Fifty-four samples of bookbinding leather samples were examined for the Government Printer. This work is resulting in a slow but gradual improvement in the quality of the bookbinding leather obtained by the Government Printing Office.

A cooperative investigation on antiseptic dyes was carried on with the Walter Reed Hospital laboratory. In cooperation with the Army Medical School a study was conducted on the efficiency of mercurochrome as compared with that of tincture of iodine against organisms found in war wounds.

In addition to the work mentioned, chemical work was done for the Army, the Navy, the Marine Corps, the Department of Commerce, the Interior Department, the General Supply Committee, the Commissioners of the District of Columbia, the Shipping Board, the Federal Trade Commission, the Panama Canal, the American consulate at Rome, the Government Printing Office, the Veterans' Bureau, the Treasury Department, and the Congressional Joint Committee on Printing.

ENFORCEMENT OF THE NAVAL STORES ACT

Active enforcement of the naval stores act of March 3, 1923, was started at the beginning of this year, when the first appropriation for the purpose became available. A naval stores classifier and a naval stores inspector were appointed and stationed at New York to inspect, classify, and grade rosin shipments to New York and other northeastern points, on which formal request for Federal inspection is made by the consignees, or on which it is deemed advisable to check the grading and take action under the naval stores act, and to collect samples of turpentine and turpentine substitutes which might be in violation of the act. A naval stores inspector was assigned to Cincinnati to cover the central field, and a naval stores classifier, with headquarters at Savannah, Ga., was appointed to reinspect, grade, and mark rosins originating in the South Atlantic producing territory, on which buyers request reinspection and marking under the naval stores act.

Two hundred and fifteen samples of turpentine and materials sold as such or in place of turpentine for similar uses were examined during the year. Thirty-five citations to hearings have been issued to concerns found to be violating the act.

Two surveys of rosin-grading conditions were made during the year. The first, made in the fall of 1924 and covering New York, Boston, Buffalo, and Cleveland, showed that the proportion of misgraded rosin was high. A conference of rosin shippers was held at the Bureau of Chemistry to discuss the situation revealed by this survey and to develop means for improving it. A second survey of grading conditions, made in June, 1925, in St. Louis, Chicago, and Milwaukee, revealed a decided improvement in rosin grading, although there is still need for further improvement.

Under the service features of the naval stores act, 82 lots of rosin, comprising a total of 9,946 round barrels and representing in the aggregate shipments of approximately 20,000 round barrels, have been inspected, graded, and marked to show Federal inspection, and United States grade certificates have been issued to cover them. Official analysis certificates were issued on two shipments of turpentine analyzed upon request. Samples representing two lots of rosin, amounting to 1,630 round barrels, were graded unofficially upon request and the results reported, but no certificates were issued.

The department has received the hearty cooperation of the naval stores industry during the first year of the enforcement of the naval stores act, and it is believed that there has been a marked improvement in labeling and grading rosin and turpentine, although many abuses remain to be corrected. As the industry has now had time to become familiar with the provisions of the act, a more exact compliance with its terms from this time on may be expected.

ENFORCEMENT OF THE TEA INSPECTION ACT

Tea is subject to both the tea inspection act and the Federal food and drugs act. A special act to regulate tea is necessary in order to control its

quality as well as its purity and to insure the correct labeling of imported tea. The act provides that all tea offered for entry into the United States must be inspected at the ports of entry. Only those teas which comply with the tea standards adopted by a board of tea experts, appointed by the Secretary of Agriculture, and otherwise meet the requirements of the act may be admitted.

During the last fiscal year 92,925,470 pounds of tea was examined at the various ports of entry. Of this tea 84,137 pounds, or approximately 0.09 per cent, was rejected. All of the rejections were for quality, except 5,666 pounds, which was rejected for being below the Government standard in purity.

The percentage of black tea imported during the year increased; the percentage of green tea imported decreased very noticeably; and the percentage of Oolong tea imported remained about the same. The largest increase in black teas was in the Ceylon variety. The percentage of India and Java black teas imported increased markedly, and the importation of Congou teas fell off more than 62 per cent. The only variety of green tea that did not show a decreased importation was the India green tea, which showed an increase.

The Canton Oolong, the tea which is consumed principally by the Chinese in this country, showed the most rejections, or 4.85 per cent. The varieties showing the next largest rejections were the Ceylon green and India black teas. These teas were not below the Government standard in quality but were damaged en route.

During the past fiscal year there was imported 92,925,470 pounds of tea, or 11.5 per cent less than was imported during the fiscal year 1923-24. Statistics of the Department of Commerce show that during the past fiscal year the United States exported 1,817,245 pounds of tea, nearly twice as much as was exported during the fiscal year 1923-24.

TABLE 2.—*Statistical tea report*

Port	Examined	Per cent of total examined	Passed	Rejected	Per cent rejected	Rejected for impurities	Rejected for quality
	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>
Boston.....	17,561,248	18.896	17,553,882	7,366	0.0419		7,366
Chicago.....	2,691,550	2.896	2,691,104	446	.0161		446
Honolulu.....	349,879	.377	349,879				
Puget Sound.....	11,669,761	12.558	11,668,271	1,490	.0127		1,490
New York.....	49,540,734	53.312	49,479,760	60,974	.1230	5,666	55,308
San Francisco.....	11,112,298	11.958	11,098,437	13,861	.1247		13,861
Total.....	92,925,470		92,841,333	84,137		5,666	78,471

ENFORCEMENT OF THE FOOD AND DRUGS ACT

Although the Bureau of Chemistry regards the food and drugs act as a corrective rather than a punitive measure and believes that in general the education of the food and drug industry to comply with the law protects the public and legitimate industry more effectively than do regulatory actions, nevertheless in those cases where educational methods fail it is necessary to resort to action in the courts. During the fiscal year ended June 30, 1925, 910 seizures were made and 746 criminal prosecutions were instituted for violations of the food and drugs act.

As a result of combined educational and regulatory operations, marked progress has been made toward the correction of certain outstanding evils in the food and drug industry. In a regulatory law, however, it is never possible to foresee a time when vigilance may be relaxed for the reason that in every industry there are certain individuals who must be held under constant surveillance if they are to be expected to pursue a course wholly in conformity with the law. The protection of the consumer and the law-abiding manufacturer will undoubtedly require a continual maintenance of supervisory activities under the food and drugs act. Recognizing the vast extent of the industries, involving billions of dollars worth of food and drug materials annually, the bureau in its enforcement work has found it necessary to direct its major attention to staple products and to those which by reason of their peculiar susceptibility to adulteration or misbranding or their high market value offer particularly fertile fields for sophistication.

With the funds available it is always necessary to select the lines toward which regulatory work shall be particularly directed. This is accomplished under a project system of operation. As fast as a particular industry is brought into reasonable conformity with the law, the funds used for that purpose are diverted to the supervision of other industries, giving only such casual attention to the first industry as is necessary to make certain that there is no general recurrence of violation.

CANNED SALMON

Decided progress has been made in correcting the very bad situation

which existed in the salmon-canning industry prior to, during, and just after the World War. This progress has recently been made easier by the fact that the Government has been uniformly successful in contests of the prosecutions and seizure actions brought as a result of the canning of decomposed fish. A number of hard-fought contests have resulted ultimately in verdicts for the Government. This has demonstrated to those packers who are not disposed through an innate sense of decency to put up a sound and wholesome pack that it is incumbent upon them so to revise their method of operation as to insure an article which will comply with the law. In its campaign the bureau has had the whole-hearted support of the better element of the industry, which through pressure on offending members has assisted in the process of reform.

During the canning season of 1924 a power boat was chartered and a systematic effort was made to inspect canneries in operation in southeastern and central Alaska. Because of the remoteness of the field, the canneries operating in Bristol Bay could not be inspected, but as these canneries are principally engaged in packing red salmon, an article ordinarily handled with greater care than the cheaper grades, there has not been so much need for inspection in that section. Of 72 canneries inspected, 13 were found to be packing or to have in their possession fish in a stage of decomposition, rendering it unfit for food purposes. During the 1925 season the boat was again used. Although the 1925 season is not included in the fiscal year covered by this report, the results of the inspections made are given here for purposes of comparison. The plants of 71 packers were inspected; only 2 were found to be packing or holding questionable fish. In addition to the canneries inspected in Alaska, canneries in the Pacific Northwest were inspected during the packing seasons of 1924 and 1925. In 1924, 4 canneries out of 35 inspected were found to be doing a questionable business. In 1925, only 2 of the 30 canneries inspected were engaged in suspicious practices. During the last fiscal year 25 criminal prosecutions directed against 17 packers were terminated by the imposition of fines. These cases represented actions against packers who in former years had shipped decomposed salmon.

FROZEN ORANGES

During Christmas week, 1924, the orange groves of California were visited by a disastrous freeze. The effect of a serious frost on oranges which are nearly mature is not always immediately apparent. Within a week or two after a freeze, however, the fruit begins to break down as a result of injury to the tissues, and in a very short time the pulp becomes dry and pithy and more or less worthless, depending upon the extent of the frost damage. Frozen oranges harvested immediately after a freeze may show very little evidence of damage and might be reasonably palatable if eaten immediately. If packed and shipped to the eastern market, the drying process begins before the eastern consumer purchases the article. As there is no marked external evidence of the damage, the purchaser is defrauded by receiving a practically worthless article in return for the price of good oranges. At the same time the reputation of the fruit is seriously damaged in the minds of discriminating purchasers. Most of the orange growers of California recognize it to be not only to the interest of the consumer, but also to their own best interest, to harvest and ship only sound, unfrosted oranges. A few, who are more interested in immediate returns than in the future welfare of the business, have made a practice of harvesting oranges immediately after a frost and attempting to get them onto the market without regard to the fraud thus perpetrated upon the consumer.

Following the freeze of Christmas, 1924, it was recognized that it would be necessary to patrol these orange-growing sections, as in previous frost years, for the purpose of preventing the shipment of worthless fruit to the eastern market. In this patrol work authorities of California gave their enthusiastic support, and, as a result of the combined efforts, very little worthless fruit was shipped out of the State. In a large number of cases fruit which was about to be shipped was detected by the inspectors and upon advice to the shipper that it was of such character that action would have to be taken against it when it reached the eastern market, if shipped, the fruit was voluntarily withdrawn and put through the so-called water separator, for the purpose of removing oranges showing an excessive degree of frost damage, or diverted to legitimate technical uses.

BLUEBERRIES AND CHERRIES

During the 1924 canning season assistance was given the blueberry canners of Maine in selecting those berries which were sufficiently free from maggot contamination to be fit for canning. An apparatus for removing maggoty berries devised by members of the bureau during that season was very generally adopted during the 1925 season and very successfully used by the blueberry canners.

A similar problem arose in connection with the cherry-canning industry of New York, which by reason of worm infestation suffered a number of seizures of goods packed during the 1924 season. As a result of the agitation at that time a program of spraying was adopted by most growers during the present growing season, and a very much cleaner and more acceptable pack of cherries was made during the canning season of 1925.

SARDINES

Another industry which has shown a very material improvement is the sardine-packing industry of Maine. It has been the practice over a period of years to can sardines which have undergone a species of decomposition resulting in what is known as a "belly blown" condition. Canned fish of this type are classed as adulterated within the meaning of the food and drugs act. As a combined result of seizures of decomposed sardines and of extensive educational work among the packers over a number of years the pack of this season is more nearly free from this and other types of objectionable fish than in any past season during which supervision has been maintained.

OYSTERS

Investigations by the Public Health Service having indicated that typhoid cases in certain cities were caused by eating raw oysters, health and food officials gave much attention during the year to establishing an effective control of the sanitary conditions under which oysters are produced and handled.

The Bureau of Chemistry has authority over oysters under the Federal food and drugs act only when they have been shipped or offered for shipment in interstate commerce. Oysters which are polluted, whether such pollution may cause disease or not, can not be shipped within the jurisdiction of the act without violating the law.

The bureau, however, is neither authorized nor equipped to study the causes of disease. It is entirely conceivable that oysters produced in apparently unpolluted waters and handled in what seems to be the most approved sanitary manner may, through contact with a typhoid carrier or an individual in the early stages of typhoid, become a potent source of danger wholly undetected by the bureau's inspectors. Thus, where typhoid is concerned, the problem becomes one for the attention of health officials and epidemiologists rather than food inspectors.

By an act passed at the last session of Congress the sanitary control of the oyster and other shellfish industries was put under the supervision of the Public Health Service. Work relating to that control will be carried on in cooperation with State and municipal health authorities. A very satisfactory program of cooperation has been arranged between this bureau and the Public Health Service. The Public Health Service will report to the Bureau of Chemistry for appropriate action under the Federal food and drugs act interstate shipments of oysters which are adulterated as a result of having been produced or handled under unsanitary conditions. This bureau will continue its supervision of interstate shipments of oysters to insure compliance with the law in the matter of labeling and freedom from excess water.

BUTTER

Intensive sampling and examination of shipments of butter were undertaken by all of the field stations of the bureau during the months of maximum production and greatest traffic and again during several winter months, when the last lots in storage were being moved to distributing markets. A cooperative arrangement was effected also with trade bodies in some of the largest consuming markets, such as New York, Boston, Philadelphia, and Chicago, whereby dealers agreed to withhold from sale certain suspected shipments until examinations could be completed to establish the integrity of the product. This greatly facilitated the regulatory operations of the stations. During the year, 188 shipments which were not in compliance with the legal standard for butter or which were short in weight were seized, and 85 cases were developed for prosecution in the courts. This increase in the number of seizures effected over those reported

for 1924 does not indicate necessarily that there was a proportionately larger output of low-fat butter, but is thought to be due to perfected control measures and to the fact that the output of many creameries which had not been subjected to surveillance during former years was inspected.

EGGS

The condition of eggs shipped in the shell and in a frozen state was found to be a vast improvement over their condition in former years, thus indicating that the regulatory activities of the Federal and State authorities inaugurated some years ago, supplemented by the educational efforts of large receivers in terminal markets, have been successful in bringing about a marked reduction in the proportion of rots and spots included in shipments. Some of this improvement was probably due also to the cool weather prevailing during the summer of 1924, which had a decided influence in retarding the rate of spoilage between the points of origin and points where the products could be brought under proper refrigeration. During the year it was found necessary to invoke seizure proceedings on only 14 shipments of shell eggs and 5 shipments of frozen eggs and to inaugurate prosecution cases on 9 shipments of shell eggs.

PHARMACEUTICAL PREPARATIONS

The general survey of the more important pharmaceutical preparations, including hypodermic tablets and certain tinctures and fluidextracts, which was begun two years ago, has been continued according to the plan originally adopted. An effort has been made to obtain from each manufacturer a sufficient number of samples to be representative of his output. As many as 20, 30, or 40 samples from each manufacturer are taken if the extent of the business makes it feasible. When examination shows that a large proportion of the samples from any one manufacturer vary materially from their declared standards, the facts are referred to the courts for prosecution. In a few instances when a small proportion of the samples collected vary unduly from their declared standards, the attention of the manufacturers is called to the matter and court action becomes unnecessary. Practically all of the samples from several manufacturers complied closely with their declared standards.

Manufacturers have been kept advised of the bureau's program. This has resulted in the formation of con-

tact committees by the manufacturers' associations, through which helpful cooperation has been maintained. These committees have studied the factors involved in the manufacture of tablets as they apply to the accuracy of the finished product, and have made recommendations regarding the degree of accuracy which they regard as feasible to maintain. A proposed announcement containing this information has been sent to pharmaceutical manufacturers and trade journals. It is believed that the attention that has been given to this subject is resulting in increased accuracy of medicinal products. It is too soon to determine just what permanent improvement has been accomplished, but there can be little doubt that the medicaments manufactured in the future will, as a whole, be decidedly more accurate than those manufactured hitherto. This work will be continued until the quality of the goods on the American market is such as to render intensive investigation no longer necessary.

PROPRIETARY AND PACKAGE MEDICINES

During the year action has been continued on the products most prominently advertised to the public as kidney remedies, largely in pill form, until the market has now been fairly well covered. As a result practically all manufacturers of such preparations in any quantity have revised the labelings in compliance with law.

Attention has been given also to preparations represented as efficacious for appendicitis, diabetes, gallstones, tuberculosis, and similar serious disorders. Instances of flagrant misbranding are becoming increasingly rare as a result of the measures taken, aided by the support of public opinion, the attitude of the courts, and a better understanding on the part of the trade.

The labels of a number of misbranded veterinary remedies have been corrected.

Not the least important phase of this work consists in answering a steadily increasing number of inquiries from persons who submit their labels and formulas for criticism. These manufacturers are assisted by appropriate explanatory comment to a better understanding of the law as applied especially to their individual products. Such inquiries are being encouraged, and the proper handling of them is regarded as a valuable method of disseminating knowledge of the act's requirements, as well as of bringing labels into harmony with the law. Even though they receive no publicity, the results thus attained are regarded as important, since correction is accomplished without recourse to strictly regulatory measures.

PROSECUTIONS AND SEIZURES

The food and drug products involved in court actions instituted during the year are listed in Table 3.

TABLE 3.—Summary of prosecutions and seizures by Bureau of Chemistry during 1925

Product	Prosecutions	Seizures	Product	Prosecutions	Seizures
Alimentary paste.....	1		Flour.....	3	11
Apple butter.....		1	Fruit:		
Baked products.....	4		Fresh.....	6	29
Baking powder.....		1	Canned.....		33
Beverages, sirups, and flavors.....	4	27	Dried.....	1	42
Chicken (canned).....		1	Jellies.....	20	37
Chocolate coating.....	4		Maple sugar.....		2
Coffee.....	3	6	Meal (corn).....		3
Colors.....		3	Milk (powdered).....		1
Confectionery.....	13	5	Nuts.....	1	27
Dairy products:			Oils.....	16	32
Butter.....	85	188	Oleomargarine.....	1	1
Buttermilk.....	1	1	Rice.....		3
Cheese.....		4	Sauce.....		1
Drugs:			Sirup (table).....	3	3
Crude drugs.....	3	8	Soups.....		1
Remedies.....	248	34	Spices and condiments.....	3	17
Eggs:			Tea.....	1	
Shell.....	9	14	Vegetables:		
Frozen.....		5	Canned.....	10	112
Feeds.....	131	78	Fresh.....	8	24
Fish:			Vinegar.....	1	2
Canned.....	104	106	Water.....	1	5
Shell.....	43	24			
Flavoring extracts.....	19	18		746	910

INSPECTION OF IMPORTED FOODS AND DRUGS

All consignments of foods and drugs offered for entry into the United States from foreign countries come within the jurisdiction of the Federal food and drugs act. The act provides that all consignments found to be adulterated or misbranded within its meaning or that are otherwise injurious to health are to be excluded from the country. Inspections are made, in so far as the limited personnel available will permit, of the foods and drugs offered for entry at the leading ports. As it is not practicable to inspect all consignments, attention is centered on those which there is reason to believe may be adulterated or misbranded.

COOPERATION WITH STATE AND CITY OFFICIALS

The Bureau of Chemistry in 1913, at the solicitation of State officials, created an office of cooperation, the function of which should consist mainly in acting as a clearing house for the exchange of information between State and city officials and the bureau.

After a period of 12 years, the bureau is thoroughly convinced of the wisdom of this policy, which has resulted not only in providing useful information of an official character to State and city food and drug officials but also in a distinct saving in the bureau's funds. This has been accomplished by the willingness on the part of local officials to assist directly in the work of the Federal officials. Particularly in districts where long and expensive travel is involved, the local officials have been able in many instances to perform the work as well as the bureau's inspectors could, thereby saving transportation and subsistence expenses.

STAFF CONTROL LABORATORIES

In order to develop basic information for the guidance of administrative officials in the enforcement of the food and drugs act, the bureau maintains staff laboratories in Washington. These laboratories make scientific investigations relating to the composition, manufacture, storage, preservation, and methods of handling food and drug products. They develop methods of analysis for detecting adulteration and misbranding and furnish information to be used in planning regulatory campaigns. They review cases developed by the field force when special technical questions are involved. They assist the field force in

planning and carrying out surveys and campaigns to bring about compliance with the food and drugs act. The results of their work are reflected in the progress made on the regulatory projects. Some of the main lines of work for 1925 in which they assisted have already been outlined; mention may be made of other investigations carried on by them during the year.

FOOD-CONTROL INVESTIGATIONS

A study was made of the Maine sardine industry for the purpose of getting definite information on the conditions under which sardines are packed, to find the cause of the deterioration of "feedy" fish, and to determine the significance of hydrogen sulphide in canned sardines. Results of the work indicate that decomposition of "feedy" fish is primarily not putrefactive but enzymic. The presence of hydrogen sulphide in canned sardines is indicative of decomposition. The results of a study on the canning of Atlantic coast soft clams will shortly be published. An investigation of the hard-clam packing industry was made and studies of the fill-of-can of tuna fish were completed.

Much work was done on canned fruits and vegetables, including the preparation of experimental packs of string beans and tomatoes, to determine the composition of the gas in the head space.

The details of a rapid and accurate method for the determination of fat in cacao products were established and the results published. Work was begun on methods for the determination of milk solids in cacao products, special attention being given to methods for estimating casein or milk proteins. A formula for making cocoa bread was published.

Results of the year's study on the composition of alimentary pastes and the raw material used in their manufacture were published. Work on the moisture content of flour was continued.

A study was begun of the changes in the fat characteristics of cheese brought about by the ripening processes. Methods for the determination of moisture in milk powder were studied, and data on jams, jellies, and preserves were collected. Reports on baking powder, cereals, eggs and egg products, and fruit and fruit products were made to the Association of Official Agricultural Chemists. Assistance was rendered in the development of a standard experimental baking method for hard wheat flours for the

purpose of unifying and standardizing experimental baking tests now in use and making possible a comparison of results obtained by different bakers.

METHODS OF ANALYSIS OF DRUGS

Methods of analyzing drugs, particularly the assay of certain alkaloidal drugs, have been studied. Apparatus for the improvement of the processes has been devised and described in technical journals. Some of the results obtained reported in journal articles include the effects of various factors in the assay of nux vomica, belladonna, and ipecac preparations. This work is to be continued, with special attention to the assay of hyoscyamus. Very delicate methods for the detection and identification of certain phenols have been devised and published.

MICROBIOLOGICAL INVESTIGATIONS

A study of the mold group *Aspergillus*, begun about 20 years ago and systematically followed throughout this period, has been completed for publication. Molds of this genus are exceedingly abundant in food, in feedingstuffs, in stored grain, in hay, and in fodder, and even occur as human and animal parasites. In spite of their importance and abundance, however, no critical study of the whole group existed in English and none had been published in any language for more than 20 years. Studies of sections of the group are to be found in publications from the microbiological laboratory and in French and German. The study of a collection of about 350 living cultures from many sections of America, from Europe, and from the Orient has been supplemented by the examination of herbaria, by the comparison of many specimens and cultures which were not kept in the living collection, and by a careful review of the literature. This made possible a systematic arrangement of the available information on the whole group and a reliable nomenclature of great sections of the group not hitherto well known. The results of this study, which will be published in book form, cover the morphology and physiology of these molds, their biochemical activities, their use in the industries as agents in the fermentation of tannins, in the fermentation of sugar to citric acid, and as sources of enzymes, and their appearance and significance in human and animal disease.

During the year an intensive study was made of the causes and conditions

incident to "spontaneous" heat production in masses of stored feeds and feedingstuffs.

A problem of spoilage in canned food, especially as it related to botulism, involved the examination of 3,000 cans of ripe olives in connection with poisoning cases during 1924 in Wyoming. No *B. botulinus* infected cans were found among these. Bacteriologically this survey showed that in spite of all efforts to attain sterilization the packers of olives have not succeeded in attaining 100 per cent sterility in their product. The dealer and consumer therefore should continue to take precautions to prevent the consumption of spoiling olives.

A peculiar type of decomposition in shrimp, involving extensive disintegration, was frequently found. An investigation is being made to determine at what point the pack of shrimp must be protected from the entrance of the microorganism that causes this decomposition.

An investigation was made of the cause of the fermentation in chocolate-coated candies that results in large losses from bursting. Work already done having indicated the probability that such fermentation might be due to yeasts of certain sugar-tolerant species, methods were developed which made it possible to isolate these organisms when present. Many yeasts were present in practically every lot of burst chocolates examined, but comparatively few bacteria or molds were found. Examination showed that some of the yeasts were capable of growth and fermentation in concentrations approximating those of the candies in question. The manufacture of experimental lots of candy, both infected and uninfected, made it possible to show that such sugar-tolerant yeasts were responsible for the losses.

In a study of the classification of the bacteria in food products, a paper was published describing the organisms in sweet corn, beginning with the field and following the product through to the packed can.

Enteric outbreaks not traceable to known organisms or to conditions definable closely enough to form the basis of preventive measures have been reported frequently. In the study of such an outbreak from cheese the bacteriologists of the bureau were able to isolate an organism not hitherto reported in America but capable of producing similar reactions in cats. This opens a new field in the explanation of bacterial food poisoning, which should eventually lead to the reduction of suffering of this type.

MICROCHEMICAL INVESTIGATIONS

The study on microscopical methods for the determination of shell in cacao products, started some years ago, has been continued. The study of acacia, citrus, fireweed, cotton, and tupelo honeys has been completed. One of the facts brought out by the alfalfa investigation is that honey of some varieties contains only a little of the pollen from the plants which are supposed to be the source of the nectar. Microscopic studies of several stock-feeds have been made. One of these was a locust meal which originated in South Africa and consisted of the dried powdered bodies of locusts. The character of white wheat middlings was studied.

The crystalline phase of candy fondant has been investigated to determine the size of the crystalline particles in fondant and correlate this finding with some of the organoleptic characteristics, such as graininess or staleness. The compilation of optical-crystallographic data for the International Critical Tables, under the supervision of the National Research Council, has been completed and will be published at an early date. A paper on the optical properties of some amino acids was published during the year.

PHARMACOLOGICAL INVESTIGATIONS

Great variations from the physiological potency recommended in the Pharmacopœia exist in certain "bio-assay" drugs. More than 300 samples of these drugs, widely used in medicine, including aconite, cannabis, digitalis, strophanthus, squill, ergot, epinephrine, and pituitary solution, were tested. They can not be assayed chemically, but must be tested by determining their physiological effects upon various animals. Only about one-fourth of the samples tested fell within the prescribed range. Some of the products tested were 200 to 300 per cent of the theoretical strength; others were more than 90 per cent deficient. These marked variations from the theoretical standard were found in the products of both large and small

manufacturers. Practically all of the large manufacturers now maintain bio-assay laboratories and test at least a part of the drugs of this class which they manufacture. It is believed that the work done by the bureau will result in a marked improvement in the uniformity of these drugs.

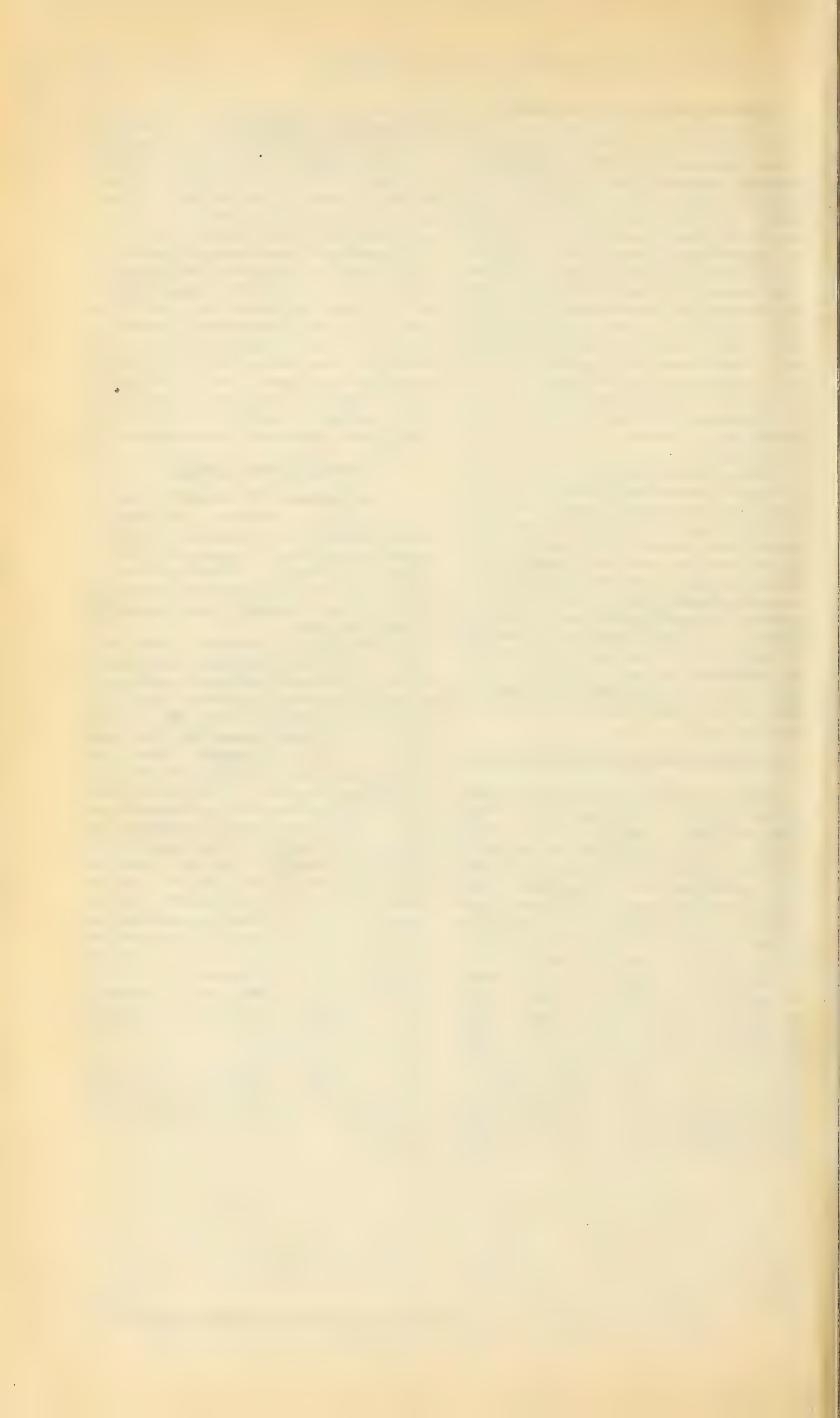
Experiments on the pharmacology of tin and on the effect of sulphur dioxide were continued. The toxicity of thallium sulphate to rats was studied for the purpose of assisting the Bureau of Biological Survey in developing the use of this substance for poisoning rats. Tests have indicated that the authentic American-grown cannabis crop is fully as active as authentic imported Indian cannabis.

PUBLICATIONS ISSUED

Six Department Bulletins, 2 Farmers' Bulletins, 1 revision of a Department Circular, 3 articles in the Journal of Agricultural Research, 3 food-inspection decisions, 1,250 notices of judgment, and 114 articles in scientific and technical journals were published during the year.

The Department Bulletins are: No. 1250, "Relation Between the Composition of California Cantaloupes and Their Commercial Maturity," by E. M. Chace, C. G. Church, and F. E. Denny; No. 1255, "Inheritance of Composition in Fruit Through Vegetative Propagation: Bud Variants of Eureka and Lisbon Lemons," by E. M. Chace, C. G. Church, and F. E. Denny; No. 1307, "Absorption and Retention of Hydrocyanic Acid by Fumigated Food Products: Part II," by E. L. Griffin and E. A. Back; No. 1312, "Loss of Nicotine from Nicotine Dusts During Storage," by C. C. McDonnell and H. B. Young; No. 1313, "Fumigation Against Grain Weevils with Various Volatile Organic Compounds," by I. E. Neifert, F. C. Cook, R. C. Roark, W. H. Tonkin, E. A. Back, and R. T. Cotton; and No. 1323, "Citrus Pectin," by H. D. Poore.

The Farmers' Bulletins are: No. 1438, "Making Fermented Pickles," by Edwin LeFevre; and No. 1452, "Painting on the Farm," by H. P. Holman.



REPORT OF THE ENTOMOLOGIST

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., September 20, 1925.

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1925.

Respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. W. M. JARDINE,
Secretary of Agriculture.

DECIDUOUS-FRUIT INSECT INVESTIGATIONS

Investigations of deciduous-fruit insects have been carried out under the direction of A. L. Quaintance, as formerly.

PEACH INSECTS

Work on peach insects has proceeded mainly along former lines. Anticipating the availability July 1, 1925, of an increase of \$10,000 for a study of the oriental peach moth, work on this insect was begun early in May by the employment of an entomologist especially competent in this investigation. Headquarters for the work were established at Riverton, N. J., in a district where the insect is prevalent and destructive. This pest is also being studied at the Fort Valley, Ga., laboratory. The work at the latter station has shown the insect to develop four or five broods of larvæ each summer in that region. Fortunately commercial orchards in Georgia have not yet been invaded to any extent, and the potential destructiveness of the insect, in view of the removal of its food with the harvesting of the Elberta, a midseason variety and the latest peach commercially grown, has not yet been ascertained.

During the late summer and fall of the year 1925, through cooperation with the Federal Horticultural Board, considerable attention was given to the determination of the present dis-

tribution of the oriental peach moth. Briefly the insect has been found in the District of Columbia and in the following States: Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Indiana, Louisiana, Maryland, Mississippi, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Texas, and Virginia. Sufficient work has not been done in the Mississippi Valley States, New York, and Michigan to determine whether it is present to any extent. Nursery inspectors cooperated during the fall of 1925, but few discoveries of the pest were made. Further observation on the insect confirms former conclusions that its severity may be expected to vary considerably from season to season, owing principally to the influence of its insect parasites, of which some 15 have already been found. The investigations under way in New Jersey and Georgia, it is hoped, will develop a method of satisfactorily controlling the pest, or at least of greatly reducing its damage.

In connection with the plum-curculio investigations continued for some years at the Fort Valley, Ga., laboratory, where various studies are under way in cooperation with the Bureau of Plant Industry of this department and the Georgia State Board of Entomology, what is apparently the first dusting of fruit orchards by airplane for the control of an insect pest was accomplished at Montezuma, Ga. About 100,000 trees were under experi-

ment, some of which were treated by airplane and some by means of ground power dusters. By means of the air dusters it was possible to apply the combined insecticidal and fungicidal dust very rapidly, and about 5,000 trees were dusted per hour, including the time required to return to the landing field and reload the outfit. The final results from airplane-dusted peach trees as compared with the results from trees dusted with ground machines indicate practically as good control of the curculio from the airplane as by the ground duster. Numerous details, however, remain to be worked out in connection with the dust itself and the feeding apparatus of the duster to make the work of the highest possible effectiveness.

In connection with the extended life-history studies of the curculio under way for some years at the Fort Valley station, observations were made on the winter mortality of the insect as influenced by the character of the hibernation quarters. Beetles confined in cages with bare ground showed a mortality of 88.3 per cent; with oak leaves in the cages, 64.1 per cent; with pine needles, 48.4 per cent; and with Bermuda grass, 36.3 per cent.

Studies of paradichlorobenzene for the peach borer, especially to determine the age of trees to which the chemical may be safely applied, have been continued at the Fort Valley, Ga., and the Vincennes, Ind., laboratories; at the latter place in cooperation with the Purdue University Agricultural Experiment Station. At the Vincennes station it appears possible to treat with safety peach trees much younger than those which can be safely treated in the Fort Valley region. In the former district nurserymen are taking up the treatment of blocks of trees with fairly satisfactory results. In connection with these studies, attention is being given to the determination, by means of a soil thermograph, of the sum of degrees of temperature necessary to evaporate a given quantity of paradichlorobenzene. This investigation was undertaken in view of the frequent periods of high temperatures that occur during the time the chemical is around the trees, with consequent danger of injury from the rapid volatilization of the insecticide.

SAN JOSE SCALE

Further experiments with lubricating-oil emulsion for the San Jose scale have been carried out during the year.

These tests have involved the use of Bordeaux-mixture emulsions, and emulsions of casein and various other emulsifiers, in reference to their efficiency in scale control and their safety to the trees, in connection with waters of varying degrees of alkalinity. The work at the Yakima, Wash., station indicates conclusively the necessity of using the lubricating-oil emulsion as a dormant spray at a strength of 4 per cent of oil to insure the greatest efficiency in scale control. Roughly, this dosage will destroy about 99 per cent of the insects, whereas the 3 per cent strength will leave about 3 per cent of the insects alive. An interesting question is raised as to the apparently higher resistance of the scale in the Pacific Northwest as compared to the scale in certain other fruit-growing districts of the country; for example, in the Ozarks. Further tests of the oil have been made on peaches in the Fort Valley, Ga., section, including the treatment, now repeated for the third year, of peach trees with emulsions of various strengths. From the year's work the conclusion has been reached that one application of a 3 per cent oil emulsion, or two applications of a 2 per cent oil emulsion, is necessary for best results in destroying heavy infestation by the insect on peach.

In the Bentonville, Ark., region, where a few years ago this pest occurred in very disastrous numbers, it has now been completely subjugated by means of the oil-emulsion spray. At the Vincennes, Ind., station further tests of lubricating-oil emulsion for the control of the San Jose scale on apple have been carried out, including tests of the oil emulsion with Bordeaux mixture, which appears slightly to reduce its effectiveness when used below the 2 per cent strength. This difference is not manifested when the oil is used at 2 per cent strength or above. Tests of lighter oils have indicated that those having a viscosity of less than 90 are probably slightly less effective for scale control than the heavier oils. In the dosage work applications of the emulsion up to 20 per cent have been made without injury thus far to trees treated. Additional tests of the oil on apple foliage indicate that such applications should be avoided wherever possible and given only when the trees are suffering severely from this scale owing to lack of proper winter treatment.

"Cat-face peaches."—A curious malformation of peaches appears to be increasing in importance each year in

the Vincennes, Ind., area. The injury is designated as "cat-face peaches," and some orchards have suffered at least 50 per cent injury the present year. Studies thus far indicate that the tarnished plant bug is responsible for a major part of the trouble.

APPLE INSECTS

Studies of apple insects have been carried on at several of the bureau's field laboratories. At the Bentonville, Ark., station special attention has been given to further investigations of various apple leafhoppers, of which several species occur in injurious numbers in that territory. The work has involved detailed biologic investigations of *Erythroneura obliqua*, *E. maculata*, *Typhlocyba rosae*, *Empoasca fabae*, and *E. maligna*, and spraying and dusting experiments in their control in orchards. It is expected that by the close of the present growing season this investigation will have been completed, when manuscript will be prepared giving a detailed report on the work. Little attention was given to the codling moth at the Arkansas laboratory in view of the thoroughgoing studies on this insect already accomplished in that section.

At the Yakima, Wash., laboratory further studies of the European red mite have been made, including biologic observations and control work in orchards. The life-history studies have been fairly well completed, and the experiments in orchards conclusively show the effectiveness of a 3 per cent lubricating-oil emulsion against the winter eggs and of a 0.5 per cent strength of the same spray material during the summer against the mites and summer eggs. Manuscript on these studies will be prepared and submitted for publication by the close of the present season. Apple aphids also have been studied at the Yakima station. Tests of lubricating oils as summer sprays have shown a fair degree of control, and by the addition of one-half the usual quantity of nicotine sulphate containing 40 per cent of nicotine to the emulsion its effectiveness is greatly increased. In other words, a spray containing 0.5 per cent of lubricating oil and nicotine sulphate (40 per cent nicotine) at the rate of 1 part to 2,000 parts of water is, during hot weather, entirely effective against apple aphids. At this station studies of various apple tree hoppers have been continued and this work is nearing completion. It has been found that a

dormant oil spray will kill a large percentage of the winter eggs of these insects. During July an investigation was made of an outbreak of the snowy tree cricket in southern Idaho. The insects were doing much damage, especially to prunes. The outbreak appears to have been local and has already been reported upon in an entomological journal. Certain studies of the codling moth have been continued, especially to determine the value of oil sprays as ovicides, and the effects of the various baits for the adults in the spring. It has been found that a mash of fermented apples has some attractive influence, and small jars of mash hung in trees caught on an average three moths per tree per day during the three weeks when the adults of the first generation were in orchards in numbers. Tests have been made of several brands of calcium arsenate as replacing arsenate of lead for codling-moth control on apple, results of which will be available in the fall of 1925. At the Vincennes station banding records are being taken for the codling moth to assist in advising growers as to the best times to make spray applications.

The apple leaf roller is attracting attention by its injuries in southern Indiana, and it is being investigated along with other insects of the region. In one case there was a loss from the first brood of 20 per cent of the apples by the larvæ eating into the young fruit. Injury occurs in well-sprayed orchards, indicating the difficulty of its control.

The apple flea weevil in the Vincennes area appears to be on the increase. The best method of control, namely, clean cultivation, will interfere with the straw-mulch system followed in many of the orchards in that region. Arsenicals appear to have but a slight effect upon the beetles, but it may be that they will yield to other stomach poisons, for instance, some of the fluosilicates.

GRAPE INSECTS

Investigations of grape insects, with headquarters at Sandusky, Ohio, and in cooperation with the Ohio Agricultural Experiment Station, have been continued along the lines formerly indicated. Additional work has been done in improving various methods of applying sprays to vineyards to obtain the greatest effectiveness in the control of the respective insect pests, and requiring the minimum of man power in spraying operations. Thus,

in spraying for grape leafhoppers it is necessary to reach the under surface of the older leaves, and for the grape berry moth the grape clusters should be thoroughly treated. Tests of various types of vineyard spray booms have been conducted and a nozzle arrangement developed which has proved more satisfactory than any of the appliances previously tested. A converging spray is obtained, and both sides of one or two rows are sprayed at the same time. From seven to nine nozzles under good pressure are required for each boom, the exact arrangement and number of nozzles depending upon the size of the vines and system of vineyard pruning. It has been found that with a properly designed spray boom, operated with a power sprayer of sufficient engine power and pump capacity, very satisfactory results can be obtained. The time required is much less, and the number of men required to operate a power spraying machine is reduced from three to one.

In general the usual recommendations have been to spray for grape leafhoppers when most of the eggs have hatched and when the nymphs are present on the leaves in maximum numbers. Although treatment at this time is fairly effective, results of experiments the present season, as well as results of experiments for the last three years, indicate that much more satisfactory control can be obtained by earlier spraying. This improvement depends upon the ovicidal effect of the nicotine, as it has been found that few eggs hatched from leaves well covered on the under surface with 40 per cent nicotine sulphate at the rate of 1 part to 1,200 parts of water. Excellent results in leafhopper control have been obtained the present season by using nicotine in the mixture applied for the berry moth about one week after the close of the blooming period. Experiments are under way to ascertain the efficiency of calcium-cyanide dust as a leafhopper control, the results being compared with those obtained from dust and liquid applications of nicotine.

NUT INSECTS

Investigations of nut insects were continued, as previously reported, at French Creek, W. Va., Thomasville, Ga., and Brownwood, Tex. At the first-mentioned station the biologic and other studies of the hickory spiral borer, injurious to young hickory and pecan trees by severing stems and

branches, have been brought to a point warranting the preparation of a paper for publication. Studies made during the last several years on chestnut weevils have been practically concluded and a report prepared for publication. Studies of the hickory twig girdler, except for further necessary observations on an egg parasite of considerable local importance, have been completed, and a report is in the course of preparation. An *Agrilus* beetle, the identity of which has not yet been settled positively, is seriously injurious to hazelnuts throughout the Appalachian region from Virginia northward. The larva of the beetle girdles and kills the twigs of its host plant, at least as far north as Connecticut. This insect, along with several other more or less occasional nut-attacking species, is being investigated. A publication on insect pests of nut trees throughout the Northern and Eastern States is in the course of preparation.

Investigations of pecan insects in Georgia and Texas have been continued along the same general lines as formerly. Further experience has been obtained in the use of sprays and dusts in the control of the pecan nut case bearer and pecan leaf case bearer. The results of treating pecan trees for the former insect have shown a saving of some 20 to 30 per cent of nuts as compared with untreated trees. In addition to these major pecan pests, studies have been carried on of the pecan weevil, the obscure scale, the pecan *Phylloxera*, and certain insects of minor importance, as the bud moth, curculio, catocala, twig girdler, termites, etc. The use of arsenicals on pecan has apparently resulted in an increase of an aphid, *Monellia caryella*, perhaps owing to the effect of the arsenical on the ladybird and other enemies of the aphid.

ORCHARD INSECTICIDES

Investigations of miscellaneous insecticides have been continued at the laboratories in Washington and at the near-by field stations at Sligo, Md., and at various field laboratories in connection with specific projects. The investigation of oil insecticides in progress has been continued and enlarged by the bringing together of several projects under one group leader. Closer contact with the Bureau of Chemistry has been effected in this general field, and the following cooperative projects have been undertaken:

(1) A study of the properties of emulsions of paraffin base oils made by the use of soap and other emulsifiers, especially their stability under various conditions and their use under both laboratory and field conditions.

(2) A study of the proportions and conditions for the manufacture of the best practical emulsions.

(3) An investigation of miscible oils.

(4) A study of the removal of unsaturated compounds from petroleum oils and the value of all portions of these oils as sprays for citrus insects.

Studies of dipyriddyis and allied compounds, also in cooperation with the Bureau of Chemistry, have been continued, and an additional report on these studies will soon be submitted for publication. Studies of compounds related to pyrrole have also recently been undertaken in cooperation with the Bureau of Chemistry and several new compounds investigated and new compounds prepared. A very useful feature of the insecticide investigations has been the preparation of an annotated index of insecticides in use throughout the world. This work, under way for some years, has now reached a point where more or less complete bibliographies on special subjects may be quickly made up.

Further attention has been given to plants containing insecticidal properties, in cooperation with the Bureau of Plant Industry. In this connection further investigations have been made of insecticides derived from Derris, Pyrethrum, and *Hura crepitans*. In connection with studies of insect tropisms, an olfactometer has been developed which is fairly satisfactory for certain insects, and by its use practically all of the interfering factors can be controlled, so that the attractive or repellent responses of a given preparation can be measured. Incidental to studies of insecticides, evidence has been obtained to indicate that the odor responses of insects depend largely, if not totally, on the physiological state of the insect under experiment; thus in the case of the Colorado potato beetle the insects while young are concerned chiefly with feeding and invariably respond to food odors; as they grow older mating begins and the insect odor and sexual odor become predominant. Interesting and profitable results are expected from this line of inquiry.

At the Sligo, Md., laboratory further attention has been given to the development and testing of the higher fatty-acid emulsion as an aphicide, with particular reference to the control of apple aphids. In the course of the work it was found that the effectiveness of the emulsion was increased

when combined with a neutral soap which caused the spray to wet and envelop the aphids more completely. It has been found that fatty-acid emulsion is incompatible with lime-sulphur and Bordeaux mixture. It is compatible with lubricating-oil emulsion and may therefore be employed in this material in the delayed dormant application for apples in the control of the San Jose scale and apple aphids. Fatty-acid emulsion, without a soap spreader, may also be used in combination with arsenate of lead and colloidal sulphur.

WORK ON THE JAPANESE BEETLE

During the year work on the Japanese beetle has been considerably broadened, and Loren B. Smith has been placed in charge. Increased appropriations were made to meet the greater cost of operation, particularly of the farm-products and nursery-stock inspection. Investigational activities have been broadened and certain new lines of study undertaken. The work on parasites of the beetle has been materially strengthened, and men have been established in Japan, China, and India. Several phases of the investigational work have been completed.

An exhaustive study to determine the value of a large number of organic compounds as soil insecticides has been made during the last three years. The conclusions drawn from these studies indicate that carbon disulphide, used either as a gas or in the form of an emulsion, is superior, as a soil insecticide to control the Japanese beetle, to any of the other chemicals studied. Certain difficulties were encountered in preparing emulsions of carbon disulphide because of a tendency of these emulsions to stratify on standing. A new emulsion was developed, known as carbon-disulphide potassium-oleate alcohol emulsion. This material does not stratify on standing and has been used extensively and successfully by commercial concerns during the fall and spring of 1924.

Continued studies have been made of methods of treating soil about the roots of evergreens to prevent the distribution of the grubs in such soil along with these plants. In the past balled nursery stock has not been successfully fumigated in a closed container, since the aerial portions of the plants were injured by the gas. A closed container has been devised for this purpose by means of which plants

with a soil ball about the roots can be successfully fumigated. The method consists in the use of a tank filled to a certain level with water, a space being left between the water and the top of the tank sufficient to contain the soil balls of the plants being treated. The plants are inverted and the aerial portions submerged while the soil balls and roots are exposed above the water to the action of the gas. Carbon disulphide has been found the most satisfactory fumigant. This method may be practical for large-scale treatments for certain classes of nursery stock. It was found that the grubs can be killed in soil balls from 12 to 15 inches in diameter with an 8-hour to 10-hour exposure to the gas.

Investigations were completed on the dipping of plants with a soil ball about the roots in various solutions to destroy any grubs present. Even where the soil ball is exceedingly small the kill obtained by dipping is not constant, although under certain conditions 100 per cent kill could be obtained. Any method of treatment which is to be used on nursery stock must give 100 per cent control constantly. Therefore this means of treatment will not permit certificate of freedom from infestation.

The studies relating to the treatment of golf greens and lawns to destroy the larvæ have been continued, and a proportioner has been devised which eliminates the use of a large tank as a container for the dilute emulsion. The proportioner can be attached to the hydrant and connected to the distributing hose. The flow of water and the pressure are regulated by the outfit and at the same time the required quantity of concentrated carbon-disulphide emulsion is automatically added to the water stream as it passes through the machine. Several golf clubs have treated their putting greens by this method with excellent results. This device will be of inestimable value to golf clubs, since it can be used not only in Japanese-beetle-control work, but as a means of applying many insecticides and fungicides to the greens or to lawns.

Every effort has been made to obtain additional data concerning the life history of the Japanese beetle and to compare them with the results of previous studies. In the summer of 1924 the adult beetles appeared from 10 to 14 days later than in the previous season. The heavily infested territory was much larger and now includes nearly 500 square miles of territory. In late July and early August

there were several large migrations of beetles into the city of Philadelphia, and particularly into the market districts and freight yards. Thousands of beetles appeared suddenly on several occasions in the city and disappeared almost as quickly several days later. Two of the more important flights occurred on July 28 and August 10. On both of these days the beetles were abundant in Camden as well as in Philadelphia, and infested the business section of the city. It was apparent that the beetles had been flying for several miles before reaching the city. An examination showed that the females outnumbered the males on both occasions, and as many as 20 fully formed eggs were found within the bodies of the females examined.

Surveys were made in 96 localities in the heavily infested area to determine the larval abundance. It was found in the fall of 1924 that the average number of larvæ was slightly below the average of the two previous years, although certain localities showed large increases. It was also found during the winter of 1924-25, on the basis of examinations made every two weeks, that the larvæ had not gone deeper into the soil than 7 or 8 inches at any time during the season. The average depth at which they were found was 5 inches, as compared with an average of 8 inches during the previous winter.

The ecology of the insect is being carefully studied, the object being to obtain information which may throw light on the possible future distribution of the Japanese beetle in the United States, as well as information relative to its habits should it become established in other portions of the country.

Investigations have been continued on the microorganisms affecting the Japanese beetle larvæ. It has been observed that certain bacterial forms present in the bodies of dead or dying larvæ are particularly virulent when inoculated into healthy larvæ. Some of the isolated lethal forms proved to be spore formers, and the larvæ may be killed by direct inoculation or, in some cases, by feeding on decaying matter in inoculated soil. The various organisms found have proved to vary in virulence, the virulence in many cases apparently depending upon the environmental conditions at the time of inoculation. It was found that four undescribed organisms are apparently constant in their occurrence in the alimentary tract of normal

larvæ. This project is being continued in the hope of developing virulent strains which may have some practical control value.

Considerable progress has been made in the liberation and rearing of several species of parasites. The tachinid fly *Centeter cinerea*, one of the more important species occurring in Japan, has surely become established in the United States. This parasite was recovered in 1924 from releases made in 1922 and 1923 and was found to have become distributed over an area of 12 square miles in New Jersey. At the close of June, 1925, this parasite was found to occur over approximately 40 square miles in New Jersey, and during the month of June beetles bearing the eggs of this species were relatively common in the Riverton-Moores-town area. In the summer of 1924 a colony of this parasite was established near Torresdale, Pa. Parasitized beetles were later collected at this point, thereby indicating the probable establishment of this species in Pennsylvania also. The tachinid *Ochro-meigenia ornioides* was successfully shipped for the first time from Japan to New Jersey. A sufficient quantity of these parasites was received to permit of releases in the field. Large shipments were also made of a dextiid fly, *Prosema siberita*, and colonies were released both in New Jersey and in Pennsylvania. Several species of *Tiphia* have been received, reared, and released. Much of the parasite material shipped from the Orient to New Jersey has arrived in the dormant or immature condition. Attempts will be made in 1925 to ship the live adults and in this way reduce the heavy mortality which has been occurring, as well as the large amount of expense and labor necessary when the parasites are reared after they have been received in New Jersey.

Continued progress has been made in the study of methods of control of the adult beetle. The results obtained from spraying with 3 pounds of arsenate of lead to 50 gallons of water indicate that a fairly good protection to both fruit and foliage may be obtained with this material. The kill which is obtained is not very great. In order to obtain a larger kill a preparation was devised consisting of a mixture of lead arsenate and an insoluble soap such as lead oleate. Cage experiments and field tests carried on during the past two years indicate this to be a most excellent insecticide against this insect. Another preparation was devised consisting of a

poison, such as lead arsenate, intimately mixed with a fatty acid, such as oleic acid, and this has proved effective. When this mixture is sprayed on the foliage, the oleic acid on drying forms more or less of a water-resistant film holding the particles of arsenate of lead to the foliage for considerable periods of time. Apparently it reduces the repellency of the arsenate of lead, and as a result is eaten more readily by the beetles.

For the last three years investigations have been under way to find a material which would be decidedly attractive to the beetles and which could be combined with a poison spray in such a manner that the beetles would feed readily on the sprayed foliage. From a study of the various essential oils derived from the favored fruit plants of the Japanese beetle and the several constituents of the oils, a material known as geraniol was found which is decidedly attractive to the beetles. Experiments have demonstrated that by using exceedingly dilute mixtures of geraniol and placing it in the field the beetles can be attracted in large numbers for a distance of nearly one-half mile and can be concentrated on plants in a relatively small area. There they may be killed by a contact spray, or they may be caught in traps, or killed by allowing them to feed on a poisoned bait. Traps have been devised which, when baited with geraniol, will capture as many as 3,000 beetles an hour during the time when the beetles are active. Poisoned baits consisting of some carrier, such as bran and molasses, mixed with geraniol and a suitable poison, have been successfully used. It is anticipated that this material, as its uses are developed, will prove of very great value. Extensive investigations are being carried on relative to the use of arsenical substitutes as poisons for the Japanese beetle. Studies are also being made in connection with the influence of spray deposits on the foliage and on the movements of the beetles. Further work is being carried on relative to the development of an efficient and cheap contact insecticide. There are several materials which can be successfully used to kill the beetles when used as direct or contact sprays. The purpose of the present investigations is to select and improve the most promising ones.

QUARANTINE AND INSPECTION WORK

In cooperation with the States of New Jersey, Pennsylvania, and Dela-

ware, and with the Federal Horticultural Board, the prevention of the spread of the Japanese beetle has been enforced to the fullest extent possible with the funds available. A revision of Notice of Quarantine No. 48, effective April 9, 1924, included an area of 3,289 square miles, which contained a population of approximately 2,813,658 people. During the summer of 1924 the inspection included most of the farm products found in the Philadelphia markets, as well as many articles shipped direct from the farms. The inspection also included nursery, ornamental, and greenhouse products, sand, soil, earth, peat, compost, and manure. The inspection of farm products was operative during the period from June 15 to October 15, whereas the inspection and regulation of the movement of nursery stock and products was effective throughout the year.

It was found by the close of the season of 1924 that the beetles had spread over a territory of approximately 5,122 square miles. In addition to this, three beetles were found on Montgomerys Island, near Milton, Pa., at a distance of about 100 miles from the main infested territory. Much of the spread occurred in the southern part of New Jersey, and all portions of this State south of the Raritan River, except a few townships in Monmouth County, were included in the quarantined area. The spread westward in Pennsylvania was about normal. Several beetles were found in the city of Wilmington and the townships in northern Delaware.

In the State of New Jersey 1,612,287 packages of farm products were certified during the summer of 1924. From these, 68,476 beetles were removed from sweet corn, 519 from peas and beans, 30 from tomatoes, 4 from cabbage, and 1 from cherries. In addition, 809 packages of various outdoor-grown flowers were inspected, from which 128 beetles were taken. Inspectors were maintained on call at strategic points throughout this State and inspected all quarantined products which the growers desired to ship to points outside the area. Inspectors were also placed on main roads leading out of the regulated area whose duty it was to stop all trucks passing out of the area which were hauling quarantined produce. In case it was found that such products were properly inspected and certified they were allowed to proceed, otherwise they were turned back. Twenty-eight cases of violation of the quarantine in the

State of New Jersey were turned over to the New Jersey Department of Agriculture for action. The violators were warned and signed affidavits that they would make no further violations. Approximately 86.5 per cent of all the inspected products were carried out of the area by automobile truck, only about 13.5 per cent having been shipped by rail.

In Pennsylvania the problem relates more particularly to the markets and commission houses in the city of Philadelphia, since very little grown on farms outside of the city is shipped to points beyond the quarantined area. In Philadelphia many products could be inspected and certified according to the regulations. Certain other articles were of such a nature that they could not be inspected, and in the case of these the quarantine operated as an embargo. Platforms were constructed at three points convenient to the markets and all produce consigned to points outside was hauled to them, inspected and certified, and then allowed to proceed to its destination. In all, 42,852 shipments of produce were certified from the city of Philadelphia during the summer of 1924. During periods when the migratory flights of the beetles occurred it was necessary to refuse inspection and certification of all farm produce owing to the large number of beetles flying in the market districts and freight yards. Beetles were observed flying into open cars of produce and several carloads shipped on July 23, immediately preceding a heavy flight, were followed to their destination, and one car opened at Reading, Pa., was found to contain 200 beetles which had flown into the car as it was being loaded. Several carloads of bananas loaded on the same day were followed to their destination, but no beetles were found in these cars. At the limits of the regulated area all possible roads were conspicuously posted with large signs giving information regarding the restrictions of the quarantine. Inspectors were placed on all principal roads for 24 hours a day, and the road inspection was maintained by a large force of department inspectors supplemented by 17 State police during the height of the season. An office was established in Wilmington, Del., which was charged with the responsibility for the work in that State, which consisted largely of road inspection to prevent uncertified produce from entering uninfested portions of the State. A small amount of inspection and cer-

tification of farm products was done in the township of Brandywine, in northern Delaware.

With the extension of the quarantine to include southern New Jersey the shipment of sand and soil used for molding purposes and for the manufacture of glassware became an item of considerable importance. It was found during the season of 1924 that 11,928 carloads of sand and soil were shipped from the quarantine area to 20 different States, as well as to several points in Canada. In the future much of this sand and soil will require chemical treatment before it can be shipped out of the area.

When the quarantine on nursery stock was first enforced several years ago it was realized that an embargo on the movement of nursery stock with soil about the roots out of the Japanese beetle area would work a serious hardship on nurserymen and others located in the area infested or which would soon be infested. The policy was adopted that, provided treatments were found which would *entirely free the soil from infestation*, plants with soil about the roots would be certified for shipment after having been treated. Several of the large nurseries are infested, and during the fall of 1924 it was necessary to treat large quantities of evergreen stock. As a result of the investigations which have been carried on for the last several years, it was possible to apply a method of treatment which rendered the soil absolutely free from infestation without injury to the plants. This consisted in the application of a large quantity of dilute carbon disulphide emulsion to the soil about the roots of the plants. During the fall of 1924 about 10,000 evergreen plants were treated by nurserymen under the supervision of inspectors of the United States Department of Agriculture. These plants were later certified for shipment to points outside of the infested area. In the spring of 1925 over 30,000 trees were successfully treated in this manner. Certain types of stock are either grown in such a manner that they can not be successfully treated by this method or else are so tender that they are injured by the chemical. For a few classes of such stock it has been found possible to use an emulsion of wormseed oil with effective results. A few classes of stock present a problem which as yet has not been solved, and studies are being made to solve it. The nurserymen are required to fur-

nish all the necessary materials for the treatments and enough men to assist. The actual operation of treating the plants is controlled and supervised by the inspectors. Should any conditions arise during the course of the treatments which might lead to a suspicion that any treatments might not be 100 per cent successful, certification is refused.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH

This work has been continued under the direction of A. F. Burgess. Field headquarters are maintained at Melrose Highlands, Mass., and the laboratory, suboffices, and storehouses have been continued as during the last fiscal year. This division cooperates harmoniously with all the infested States.

FIELD WORK IN THE BARRIER ZONE

The barrier zone, which was outlined last year, embraces a strip of territory from the Hudson River to the eastern boundary of Berkshire County, Mass., and averages about the same width north to the Canadian border and south to Long Island Sound.

The New York Department of Conservation conducts scouting and clean-up work throughout the southern part of the strip that is located in that State, while the bureau is doing similar work in the northern part of the New York area and in the balance of the zone in Vermont, Massachusetts, and Connecticut. The State of New York is also carrying on clean-up work in three small areas on Long Island, and the insect is nearly exterminated in these localities.

During the previous fiscal year the funds available were not sufficient to scout all of the territory in the barrier zone. With the additional funds made available during the present fiscal year it has been possible to scout all the towns in the zone and to determine the condition of the territory and its suitability as a barrier.

No new infestations were located in towns previously scouted except at Benson, Leicester, and Pownal, Vt., and at Stockbridge and Sheffield, Mass. These infestations were all small and should be cleaned up this year. Of the towns scouted this year where no work was attempted during the fiscal year 1924, infestations were located at Norfolk and North Canaan, Conn., and at Chesterfield and Moriah, N. Y. No infestations were found in

the towns of Fairfield, Charlotte, Salisbury, Castleton, and Bennington, Vt., Williamstown, Cheshire, Dalton, Pittsfield, and Alford, Mass., and Salisbury and Hamden, Conn., during the fiscal year 1925, although small infestations were located in all the towns mentioned during the scout of the previous year. With but few exceptions the clusters were greatly reduced in number in the towns found reinfested.

In the section of the zone which is being handled by New York State 11 infestations were found this year. Several localities found last year were cleaned up, and with the treatment applied during the spring of 1925 the number should be further reduced.

In the fall of 1924 a gipsy-moth colony was found by assistants of the entomological branch of the Dominion of Canada near Henrysburg, Quebec, about 3 miles north of the international line. It is so situated that it can be readily exterminated, and is being thoroughly treated by the Canadian department.

It now seems that the plan for maintaining the barrier zone is feasible and there is every reason to believe that it will be possible within the next two years to discontinue work in some of the towns where no infestation has been found and to move the line eastward. Prior to this, however, some scouting work should be done, particularly in the valleys extending to the westward from the Hudson River, and plans have been made by the New York Conservation Commission to start this during the coming fiscal year. Some additional work will be required on Long Island, but it will be carried on by the State force.

FIELD WORK IN NEW JERSEY

As the result of scouting work in the fall of 1924 in the worst infested part of the area in New Jersey it was found that the infestation had been reduced to such a point that it was possible to curtail the work in that area in order to release men to carry on extensive scouting operations in the territory surrounding the entire infested area. This work was begun in January and a strip of towns approximately 10 miles in width was scouted. One small colony was found in the residential section of Elizabeth, N. J. It has been treated, as well as all the infestations in the central area. This work marks the beginning of the closing-in process which will result in the gradual reduction of the territory by working from the outside

toward the center. The condition of the territory is better than ever before. In order to complete this extermination project it will be necessary to make heavy expenditures during the next two years, but after that period the cost of the work can be gradually reduced.

The weather during the spraying season was unusually favorable and a greater acreage was treated than heretofore. The effectiveness of the spray was greatly increased by the use of fish oil as a sticker.

A light truck sprayer has been devised and put into operation in the barrier-zone district during the present season. The results have been very satisfactory and indicate that the use of such a machine is feasible where small colonies have to be treated and mobile apparatus is required.

QUARANTINE AND INSPECTION

On July 1, 1924, the Federal Horticultural Board extended the area which was under quarantine for the gipsy moth so as to include the entire State of Vermont, and a few towns were added in Maine and Connecticut.

The inspection work in the quarantined area has been readjusted by combining a number of quarantine districts and by having the district foremen who take charge of sections of the barrier zone handle also the inspection and quarantine work in their districts. This has made it possible to conduct the work without increasing the permanent force.

On account of the rearrangement of the quarantined area, particularly in Vermont, and the lifting of State embargoes against the shipment of Christmas trees and greens, an enormous volume of this material was shipped during the fall of 1924. So great were the demands for inspection that it was necessary to transfer temporarily over 100 men from the scouting and extermination project to take care of this additional work. The volume of nursery products shipped during the year has been heavier than usual, the number of certificates issued on this class of products being 50 per cent greater than for the previous year. A total of 121,410 certificates and permits were issued during the year.

FIELD AND LABORATORY RESEARCH WORK

The European parasite work has been continued during the year in Spain and Portugal, and also in Hungary, Poland, and Czechoslovakia, and

much information has been gathered as a result of observations made in infested areas in surrounding countries.

Methods of shipping parasites have been greatly improved, and the material has arrived in better condition than in previous years. This has been due partly to cooperation and help obtained from the various embassies in European countries, the one at Paris having given much assistance in expediting shipments. The steamboat officials and the United States dispatch agent at New York have assisted materially in facilitating the delivery of shipments.

One lot of parasites, *Apanteles vitripennis*, was brought back from Europe to Melrose Highlands by one of the entomologists on the laboratory staff and received constant care en route. This proved to be the most feasible method of handling this particular species. In previous years most of the specimens of this species, shipped in the usual way, died en route. The biological work on a number of the new introductions has been carried on with great care; methods of handling have been improved and additional information obtained as to the best method of shipping different types of parasites.

The work of checking up field parasitism in the infested area in New England indicates that the percentage is not so great as during the previous year. Breeding and colonization work has been continued with practically all of the parasites that have already been successfully established. Most of the colonies have been placed in, or immediately adjoining, the barrier-zone area, and several colonies of *Compsilura concinnata*, a tachinid fly that attacks many native hosts as well as the gipsy moth and the brown-tail moth, have been liberated in New Jersey.

Several papers dealing with the biology and morphology of introduced parasites have been submitted for publication. The building and successful operation of a light power sprayer, mounted on a 1-ton truck, together with the development and successful use of fish oil as an adhesive, are among the most striking results secured during the year.

THE PRESENT STATUS OF THE GIPSY-MOTH PROBLEM

The results of the field work in New Jersey have been very encouraging and the condition in the barrier zone is satisfactory. The whole area has

been thoroughly scouted, the small number of colonies found have been treated, and the infestation as a whole is less than during the previous fiscal year. Cooperation by the State of New Jersey on the former project has continued during the year, and the State of New York has handled a large part of the area in the barrier zone that lies within its boundaries. All of the New England States have assisted in the zone work or on other projects.

Gipsy-moth infestation over the greater part of the infested area has not been serious enough during the year to cause much heavy defoliation. Field observations extending over the greater part of the area indicate, however, that the insect is slightly more abundant this year than during the year previous. A notable exception to the first of these statements is found on Cape Cod, where widespread defoliation took place in nearly all of the towns between the Cape Cod Canal and Orleans. Careful observations indicate that nearly 25,000 acres were completely defoliated and that nearly as large an area suffered partial defoliation. In the same towns during the previous year no large areas were defoliated, and this sudden outbreak, which occurred in spite of the fact that many species of parasites were well established in this region, is a cause of much anxiety as to what may happen later in other parts of the infested territory.

The brown-tail moth was less abundant than during the previous year, although small defoliated areas were present along the seaboard in New Hampshire and southwestern Maine.

CEREAL AND FORAGE INSECT INVESTIGATIONS

G. A. Dean was charged with the work of this section until his resignation June 1. W. R. Walton acted in charge for the rest of the fiscal year.

EUROPEAN CORN BORER

During the year this pest has spread rapidly in the northern part of Ohio, southeastern Michigan, and northwestern Pennsylvania. The area added by this extension of territory was nearly 9,000 square miles. Of this area more than 4,000 square miles are in Ohio, but Michigan was invaded to the extent of more than 2,000 square miles. It is probable that this dispersion occurred by the flight of the moths, but whether these all originated in the United States is a question that can

not be answered at present. The infestation which has existed in southern Ontario for several years increased in intensity so greatly during the past year that the situation here is regarded as grave, and it is altogether possible that large migrations of moths from this region reached both Michigan and Ohio. The corn-borer infestation in the Ohio-Michigan area has trebled in intensity since the last account of the conditions prevailing there, although an earnest effort to clean up the infested fields was made during the spring of 1924. Since that time all of the infested States of the Lake region have enacted compulsory clean-up legislation, and the enforcement of these regulations has begun. The method of enforcement was made the subject of a conference of State and Federal regulatory officials held at Cleveland, Ohio, July 21, when uniform action was agreed upon. It is hoped that by these means the repression of the pest may be facilitated. During the summer of 1924 it was found that a slight infestation which occurred last year in Brooklyn, New York City, had extended across the Narrows into contiguous territory in Staten Island. This area was thoroughly burned over during the spring of 1925 under ideal weather conditions, and it is believed that the insect has been brought under control. The work of introducing the insect parasites of the corn borer from Europe, as mentioned in the last report, has progressed very satisfactorily during the year. New species of promising character have been secured and liberated in this country. Two of the species already liberated have been recovered from field collections this year, indicating that they have become established. One of these was found in the important Lake area bordering the Corn Belt, where the corn borer eventually must be most vigorously combated. Several additional promising species of parasitic enemies have been discovered in Europe by bureau investigators.

The States invaded by the pest have increased their appropriations for control work during the year and are giving excellent cooperation in this work. This particularly is true of Pennsylvania, Ohio, and Michigan. In the New England area the progress of the infestation apparently has been at a standstill recently, although some evidence of increasing intensity has been observed during the last few weeks. In the immediate vicinity of Boston comparatively little injury to

corn has been noted during the year, although the pest is present in some numbers.

ALFALFA WEEVIL

Good progress has been made in the experimental control of the alfalfa weevil by spraying methods, and a publication has been issued in cooperation with the University of Nevada, as Bulletin 108 of that institution. The feasibility of applying an efficient insecticide in dust form by means of airplanes is indicated by preliminary experiments conducted during the year.

The pest has continued to spread into California and was found in Plumas and Lassen counties during a recent survey. A most significant feature of this reconnaissance was the discovery of the insect in the territory lying along the North Platte River in eastern Wyoming. This marks the entry of the weevil to the great fertile basin of the Mississippi River, and its advent there may be fraught with grave results to the alfalfa-growing industry of this important region. Infestations are reported from Douglass, Careyhurst, and Orin Junction, all in Converse County; from Casper in Natrona County; from Glendo in Platt County; and from Lander in Fremont County. Glendo and Douglass are about 35 or 40 miles from the western boundary of Nebraska, and there is a railroad running directly from the infested area into the great alfalfa-growing section along the Platte River in Nebraska. Additional funds for survey work became available July 1 last, but as effective work of this kind can be done only for a period of about six weeks, lasting from the middle of May until the last of June, the work can not be resumed until May of 1926, when it is planned to conduct a more thorough campaign. Without doubt this is the most important development that has yet occurred in the alfalfa-weevil situation and emphasizes the necessity for intensive work on this problem.

GRASSHOPPERS

The grasshopper situation in central Texas, mentioned in my last report, has continued to improve, and, owing to the vigilance of the State and Federal workers, the outbreak has been almost entirely overcome.

A similar condition which threatened in Hastings and Jefferson Counties, Okla., was overcome through co-

operative action of this bureau with the officials of the State experiment station, although for a time the situation seemed desperate. Sporadic outbreaks of local interest occurred in California and Arizona, but no large regional infestation seems imminent at this time. Good progress has been made in the investigation of improved methods of attacking grasshoppers and crickets, and it is expected that a report on this phase of the work will be ready for publication some time in the coming year.

HESSIAN FLY

There are some indications in the North-Central States that a general wave of Hessian-fly infestation is starting, although conditions at the present writing are not serious and comparatively little loss from this pest was experienced during the year.

SOUTHWESTERN CORN BORER

Among the insects of potential importance which are being kept under surveillance is a boring caterpillar inhabiting the stalks of corn in western Texas, New Mexico, and Arizona. It has been called the southwestern corn borer, and is a close relative of the larger corn stalk borer of the southeastern coastal plain region of the country. Unlike that insect, however, it inhabits the table-lands of the Southwest up to elevations of more than 4,000 feet. Infestations involving as high as 100 per cent of the stalks in a given field have been observed in 1924, whereas in Presidio and Brewster Counties of Texas a loss of 50 per cent of the crop is reported for the year 1925. Similar reports have been received from New Mexico. Although the region now inhabited by this pest is not important from the standpoint of corn culture, there is a possibility that this insect may spread northward in years to come and invade territory where corn is of great importance. The insect is being watched by bureau investigators, and experimental methods of control have been initiated.

WESTERN CUTWORM

Immense flights of the moths of a cutworm belonging to the genus *Euxoa*, observed by bureau investigators in the summer of 1924 in New Mexico and through Colorado to Wyoming, indicated the probable occurrence during the present spring of a widespread outbreak of this cutworm.

This expectation was verified by the recent occurrence of severe injury from it throughout Oklahoma and Kansas, west of the ninety-seventh meridian. Many valuable data were obtained by bureau observers in this connection.

WIREWORMS

At the close of the growing year of 1924 the studies formerly conducted at Ritzville, Wash., in connection with the dry-land wireworms were completed and a summary of the biology has been published in the *Journal of Economic Entomology* for February of the current year. The laboratory formerly conducted at Ritzville has been transferred to Toppenish, Wash., so that studies may be initiated of a very injurious wireworm attacking a wide variety of crops under irrigation conditions in the Yakima Valley.

STORED-PRODUCT INSECT INVESTIGATIONS

E. A. Back has continued in charge of this section of the work of the bureau.

BEAN-WEEVIL INVESTIGATIONS

The investigation of weevils attacking beans and cowpeas has been continued during the year with still better results. The year's work has clearly proved that the danger of infestation in the field is from the adult bean weevils that are maturing in seeds held in storage and not from the planting of weevily beans or from carelessness in harvesting, as formerly thought. It has always been a habit for many farmers to hold over from one season to another stocks of beans or cowpeas which for one reason or another were not marketed in the year of harvest. In such stock weevils breed generation after generation so that by the time the new crops have matured there are present in neglected storage places myriads of adult weevils that instinctively fly to the field and infest the maturing crops by laying eggs upon the pods or seeds. Large numbers of small samples of beans have been obtained from various farms and portions of farms. Examination of these has made it possible to state where sources of infestation in storage occur. These results which have followed much tedious laboratory work have greatly impressed the California bean growers, and for the first time they have turned their attention to the treatment of

seeds in storage for the purpose of eliminating the supply of adult weevils from the fields. All facts developed in the scientific studies in the laboratory have been digested and their practical application brought to the farmer through numerous meetings and the work of local bean-weevil committees formed in cooperation with county farm advisers and State officials. Farmers through their committees have appropriated funds for the printing of posters carrying practical bean-weevil facts developed by the bureau.

The practical control work of the year has meant much in preventing losses. The growing of navy beans along the Atlantic seaboard has been discontinued in many places because of weevil destruction. The same trend from freedom from infestation to the development of heavy infestations has been repeated in the more newly developed bean-growing areas of California until in the Chino district the loss in 1922 was as high as 85 per cent for the entire community and so excessive in some sections of Merced County that bean growing has been discontinued. It has been estimated by certain bean growers that the California bean industry is suffering an annual loss of from 10 to 25 per cent of its crop. One Modesto farmer lost \$1,000, or 50 per cent of the sale price of his beans, in 1920, and \$1,000 out of \$1,235 during 1921. He gave up bean growing until 1925, when he learned that he could grow a clean crop by following the department's recommendations.

These few instances of actual depreciation of consigned crops due to weevil development indicate the seriousness of the California bean-weevil situation and explain why in such regions as Merced and Stanislaus Counties, where the bean acreage is estimated at 35,000 and 50,000, respectively, the growers are so heartily behind the department in attempting to bring about a practical cooperation among the growers for the elimination of sources of infestation. The feasibility of practical control on a large scale has already been proved by the work of the bureau's experts. If California bean growers can cooperate in the destruction of weevils in storage their losses on the bean market will be reduced to a negligible factor. Losses are being prevented. And this prevention of loss has developed from the purely scientific studies of the biology of the bean weevils.

Six papers containing new information have been prepared and submitted for publication during the year.

GRAIN FUMIGANTS

In my last report attention was called to the cooperative work between the Bureau of Chemistry and this bureau following the request made to the Secretary of Agriculture by the General Managers' Association of Chicago (representing the leading railway systems of the United States) that experiments be conducted to develop a fumigant of grain in grain cars more suitable than carbon disulphide, the use of which had been prohibited except at points in Baltimore and New Orleans. Department Bulletin 1313 has been published giving data of experiments referred to in the report for 1924. At the time of that report it was believed that the ethyl acetate-carbon tetrachloride mixture offered an excellent substitute for the well-known and efficient carbon disulphide. It was believed that the one great objection to the new fumigating mixture, namely, the residual odor left on the grain after fumigation, would be overcome by the development of a commercial grade of ethyl acetate that would be free from odor. The attention of farmers and grain dealers was called to the possibility of the new fumigant as one free from the fire and explosion hazard when properly used. The past season's experiments on a large scale have established the effectiveness of the fumigant for use in both grain cars, grain elevators, and exceedingly well-constructed farm cribs. Quite contrary to expectation, however, it has not seemed possible to obtain a commercial grade of the fumigant that will not leave an objectionable odor on the grain. The result has been that grain dealers and grain elevators have discontinued the use of the ethyl acetate-carbon tetrachloride mixture. Unless a better commercial grade can be made available or the grain trade educated up to taking grain carrying the odor of the new fumigant, more experimental work will be required.

In the year a report was published indicating that in the fumigation of tightly constructed chests and closets in domiciles where the odor is not a deciding factor the ethyl acetate-carbon tetrachloride mixture may be used in place of carbon disulphide. Two professional bulletins under the joint authorship of the Bureaus of Ento-

mology and Chemistry have been published giving the results of detailed experiments with fumigants for grain in railroad stock and dealing with the subject of absorption and retention of hydrocyanic acid gas by fumigated food products.

GRAIN INSECTS

The studies of insects attacking grains other than the Angoumois grain moth have progressed. Technical papers containing new scientific data have been prepared on the biology of the saw-toothed grain beetle and the yellow and dark mealworms, and department bulletins containing entirely new data on the biology of the cadelle and the granary weevil are ready for publication. Studies of other pests are under way. In Georgia and throughout the South investigations have been continued of the rice weevil as a corn pest, and on St. Simons Island in Georgia observations have been conducted to determine the actual status of the broad-nosed grain weevil, which promises to become even more destructive to corn under certain conditions than is the rice weevil.

MISCELLANEOUS INVESTIGATIONS

Miscellaneous investigations have been made, but through lack of funds could not be carried far. Investigations have been made into methods for controlling the webbing clothes moth as a destructive agent attacking raw wool, mohairs, and alpacas in yarn factories, carpet establishments, and wool warehouses. Attention has been given to the moth-proofing of fabrics. Investigations have been made in fertilizer establishments, leather houses, and meat establishments with a view to the control of the destructive hide beetle, *Dermestes vulpinus*. Special interest has centered in insects destructive to upholstered furniture. Problems of insect control in flour mills, warehouses, retail and wholesale grocery establishments, fur establishments, department stores, candy factories, and a wide range of other concerns dealing with food products have received as much attention as limited time and funds permitted.

THE ANGOUMOIS GRAIN MOTH

The investigation of the Angoumois grain moth in the eastern wheat belt has been continued. The determination of the degree of infestation in the field previous to harvest and the rela-

tion, if any, of this infestation to the holding in storage of infested wheat or corn in farm bins and granaries has been of great interest. The harvest of 1924 was late, so that wheat was in the shock in western and central Maryland from July 4 to about July 20. A survey of 35 farms where shocked wheat was located near stored grain was made. With one exception shocked wheat on the farms was found infested. The average infestation of wheat in the shock was found to be 0.26 per cent, whereas the maximum infestation was 2.06 per cent. These percentages of infestation were determined by means of samples taken at the time of harvest and should not be confused with the phenomenally high percentages that ruin wheat left standing in the shock long after harvest. It is estimated that in wheat fields where the average infestation is 0.26 per cent there are about 25,000 moths per acre of shocked wheat. Since studies have determined that female moths may lay as many as 389 eggs and that the minimum time required for the development of one generation is but one month, the practical value of this investigation is obvious.

In the last report attention was called to the severe outbreak of the Angoumois grain moth in 1922, when the percentages of wheat kernels infested on certain Maryland farms ran as high as 80 to 90 per cent. Studies during the year have been made of climatic and other factors for the years 1897 to 1924 to determine whether it might be possible to deduce from them facts that may throw light on the cause of moth outbreaks. It was found that a considerable accumulation of excess temperature from June to October and early or normal harvests have characterized moth-outbreak years in the wheat regions shipping grain to the Philadelphia market. Severe winters appear to have a repressive effect upon the abundance of the insect, and no outbreaks have occurred in a year when harvest was late. It is hoped that this information will be of service in predicting moth conditions.

DRIED-FRUIT INSECTS

The investigation of insects attacking dried fruits, particularly in California, has been reestablished during the year on a much firmer basis. The limited work of the previous year was brought to a temporary end by the resignation of the only investigator

associated with the work during the fiscal year 1924. Early in the year covered by this report, two experts were assigned to these investigations. The results have been so gratifying that the Dried Fruit Association of California appropriated \$1,000 to augment the Federal appropriation. The work of the year has been directed almost entirely to investigations having for their object the discovery of facts of immediate practical value at raisin-packing establishments. The average raisin plant combines storage features with those of manufacture. The processing routine largely frees the fruit from one of its worst enemies, namely, the saw-toothed grain beetle. But where insects are abundant, packed goods are subject to reinfestation and are therefore fumigated just before shipment. This fumigation, valuable as it may be in respect to marketed raisins, has no effect in limiting infestation at the plant. The problem of the year has been to reduce existing infestations and minimize the hazards of infestation during storage.

In processing, raisins first pass through the stemming machine, where the bulk of extraneous matter is removed. The lighter waste material, known as stemmer trash, and consisting of sand, chaff, the small cap stems, and insects, is removed on the entrance side of the machine and is collected in picking boxes of about $1\frac{1}{2}$ cubic feet capacity. On the average, 3 tons, or 120 picking boxes, of raw stock raisins produce about one box of stemmer trash. It was determined that over 95 per cent of the infestation by the saw-toothed grain beetle is removed from the raisins and falls into the stemmer trash, and as many as 154,000 adult beetles were not infrequently found in one box of such trash. Stemmer trash thus charged with insects has been formerly used as bedding material for stacks of boxes containing raw raisin stocks or for filling in uneven places about the plant yards, or it has been dumped near the plant. The result has been that thousands of beetles have found their way back into the stacks of raisin stocks or into containers of processed and often cartoned raisins ready for shipment. Since it has been found that adult beetles may live several years and lay many eggs and that the larval forms may mature in about two weeks during warm weather, no argument need be presented to condemn this practice. It invites more insect trouble not only at the plant

itself but in stores throughout the country where raisins are exposed for sale. To meet this situation the bureau expert devised a special fumigatorium of proper size to hold the boxes of stemmer trash likely to be obtained daily at any plant. Experiments have been conducted to determine the proper dosage and exposure for the destruction of beetles by fumigating the trash with calcium cyanide. The associated dried-fruit growers have appreciated the value of this work, and fumigatoriums have been built and are to-day in operation in the majority of raisin-packing plants.

Experiments to prevent the infestation of raisins stored in packing boxes in open sheds and yards at plants are still under way, although data already received indicate their practical value. Advantage has been taken of the fact that the beetles appear to crawl and not fly and that they have a tendency to crawl upward and to seek areas of lesser light intensity, to develop what has been termed an "arc barrier." This barrier is made from a sheet of galvanized iron 18 inches in width by rounding the upper 6 inches to form a perfect half cylinder of a 4-inch diameter. The storage shed is first completely surrounded by a 1 by 12 inch board set on edge, sunk 4 inches into the ground and secured to the supports of the shed. The galvanized barrier is then applied exteriorly to this board in such a manner that it extends 4 inches below the surface of the earth and with its overhanging half cylinder directed away from the shed. In the first experiment more than 6,000 beetles used were unable to surmount this hazard and enter the shed, but the value of the arc barrier can only be proved by experiments extending over considerable periods of time.

VACUUM TREATMENT

The use of high vacuum for insect control seems never to have been considered seriously by the commercial world. One of the most interesting phases of the work of the year has been the opportunity offered the bureau to conduct experiments to determine the effectiveness of a vacuum of 24 to 29 inches when used for control of stored-product insects.

Experiments have been conducted in a concrete chamber, 8 by 8 by 8 feet, specially constructed to withstand high pressures and intended for the treatment of certain warehoused commodities as a part of the equipment of a modern storage warehouse. Data

obtained already indicate that the usual fabric pests, such as are commonly destructive in stored household furnishings, as well as pests of stored food commodities, can be killed by the vacuum treatment.

When subjected to a vacuum of from 24.5 to 28 inches for 24 hours, larvae of the Indian meal moth and the meal snout moth appeared shriveled and discolored, indicating death. At the end of 48 hours larvae of the case-making and webbing clothes moths were brown and brittle, and adults of the granary weevil, the rice weevil, and *Ptinus brunnus* were dead. A vacuum of from 28 to 29 inches was found very effective in killing insects most commonly found in storage.

TROPICAL AND SUBTROPICAL FRUIT INSECT INVESTIGATIONS

Investigations of tropical and subtropical fruit insects have been carried out under the direction of A. L. Quaintance, as formerly.

FRUIT FLIES IN HAWAII

Investigations of fruit flies in Hawaii, including inspection and certification work in cooperation with the Federal Horticultural Board, have been continued largely along the lines previously reported. A total of 264,063 packages were inspected during the fiscal year, as required under Quarantine No. 13, this number being 26,443 greater than the number inspected during the fiscal year 1925. The details of the inspection work are shown below:

Inspections made.....	2,263
Packages rejected as unfit for shipment.....	185
Shipping permits issued to transportation companies.....	1,937
Bunches of bananas passed for shipment.....	242,860
Crates of pineapples passed for shipment.....	15,450
Crates of taro passed for shipment.....	3,915
Crates of coconuts passed for shipment.....	341
Crates of ginger root passed for shipment.....	18
Crates of lily root passed for shipment.....	1,294
Total packages inspected.....	264,063

In addition, inspections of baggage were made as last year. The total number of pieces examined for sealing was 2,721, the greater part of which were trunks. Inspection and sealing

of baggage at Honolulu before sailing is still very popular with travelers.

Constant collections of the Mediterranean fruit fly were made throughout the year and careful records kept of the amount of infestation by the insect in different fruits and the amount of parasitism accomplished by the four fruit-fly parasites—*Opinus humilis*, *Dinichasma tryoni*, *D. fullawayi*, and *Tetrastichus giffardianus*. These general notes will shortly be summarized for publication. A study was undertaken of the susceptibility of cooking bananas, Guatemala type avocados, and papayas to attack by the Mediterranean fruit fly. In the case of cooking bananas, observations have been confined largely to the type known as Maiaaoli, the type principally of commercial value in Hawaii. It was found that green bananas inclosed in breeding cages with flies became infested and that the insect reproduced itself under laboratory conditions. In a total of 60 green fruits so inclosed, 6,841 egg punctures were made and 223 adult flies were reared. Eight green bunches of bananas on the trees, inclosed for two days in screen cages with from 100 to 150 adult flies, showed a total of 132 fruit-fly punctures. Punctured fruit when placed in rearing jars, however, failed to develop adults. In addition to the foregoing observations, examinations of bananas have been made in the Honolulu markets. From a total of 8,000 or 9,000 bananas so examined 29 fruit fly punctures have been found, but no adults have been reared from these fruits. It appears from the observations in 1925 that the Mediterranean fruit fly can breed in these green bananas under forced laboratory conditions and that fruits under natural field conditions are frequently punctured and eggs deposited. It is thus possible that successful breeding might occur under natural conditions, and further observations are to be made to ascertain whether such breeding can take place before any modification of the existing quarantine on these fruits is suggested.

In the case of the Guatemala avocado, only a few observations were made owing to the short bearing season and the scarcity of fruits of these winter varieties. Studies indicate that infestation of some varieties of the Guatemala type may occur under field conditions, and further observations will be made during the next winter avocado season.

FRUIT FLIES IN THE CANAL ZONE

Along with the investigation of other tropical fruit insects in the Canal Zone, special attention has been given to the fruit flies, as heretofore reported. The inspections made did not result in the finding of the Mediterranean fruit fly, although it is possible that the Mexican fruit fly has been found. Further study of this suspected material will be necessary before positive identification can be made. The survey for insect pests has been continued throughout the Canal Zone and additional data obtained. A species of *Hylesia*, which formerly was found almost wholly on mango, was found abundantly on avocado, stripping the trees of their leaves. An interesting *Ichneumon* parasite of this insect was reared.

Experiments have been made in the control of ants of the genus *Atta* by the use of calcium cyanide introduced into the nests with a dust sprayer. The treatment was found very effective as well as practical. In cooperation with the branch of forest insect investigations of this bureau, further tests of variously treated woods, as well as untreated kinds, were continued to determine their resistance to termite attack. In the matter of plant quarantines distinct progress can be reported. A new agricultural law passed by the National Assembly of the Republic of Panama contains provisions for plant quarantines, and their urgent need is fully realized.

GREENHOUSE INSECTS

Owing to the increasing importance of the bulb industry in the United States, special attention during the year has been given to investigations of the two bulb flies. Bulb material infested with larvæ of the narcissus fly or larger bulb fly was obtained and observations made upon them in the laboratory in Washington. It was ascertained that the larvæ pupate at or near the surface of the ground above the decayed bulb in which they fed, and the puparium is usually found in a slanting position partially submerged in the burrow. The pupal stage appears to require three weeks or longer. The adult flies emerged in the spring, during late April and May. It is believed that mating takes place only in the sunlight. Their small, elliptical white eggs are deposited on or near the bulbs; these hatch in three or four days. In the

case of the lesser bulb fly adults were reared from infested bulbs received from California and then fed in cages. The flies fed readily on honey. They deposited their small, white eggs in masses on the dry, brown skin at the neck of sound bulbs. None was found in or on decaying bulbs. Some larvæ that hatched August 26 pupated a month later, emerged in October, and laid eggs, whereas others of the same brood did not emerge until January. In order to study the bulb flies to best advantage the laboratory at Willow Grove, Pa., where work in cooperation with the Pennsylvania State Department of Agriculture has been in progress, was transferred to Santa Cruz, Calif., where the insects are prevalent. Careful investigation of these insects for a year or two will, it is hoped, throw light on practical methods of control.

Some time has been devoted to biologic studies on the development of the greenhouse mealybug, *Pseudococcus citri*. Observations especially were made on the incubation period and on the nymphal and adult development under varying conditions of temperature and humidity. The duration of the egg stage may prove to be of great importance in determining the intervals at which fumigation would be most effective. Temperature and humidity readings were recorded in connection with these studies and will be correlated with variations in the life cycle. At the Willow Grove, Pa., station studies and observations on the cyclamen mite have been continued and new facts accumulated. The adult females and eggs of this pest were found to be able to survive the low temperatures of the past winter on perennial larkspur, *Delphinium belladonna*, and snapdragon, *Antirrhinum* sp. A 1 per cent lubricating-oil emulsion has shown favorable results against the mites, although repeated applications appear unfavorable to the cyclamens as reducing the number of leaf buds. Experiments with various soap solutions as sprays for this mite are now under way. A planting of 40,000 narcissus bulbs and 5,000 tulips was recently found to be infested with this mite, constituting an additional host record for this pest. Studies on the seasonal development and number of generations of the Cattleya fly have been completed during the year. Of the various materials tested for the control of this insect nicotine dust containing 2 per cent of free nicotine was found to give satisfactory control. Additional work in the field of

fumigation has been accomplished. The effects of vacuum fumigation with hydrocyanic-acid gas in varying dosages on the vegetative and flowering qualities of amaryllis bulbs have been studied, and the indications are, from the blooming records of the plants, that the treatment with this gas does not affect the flowering qualities of the bulbs; in fact, the treated lots were in all respects better than the control plants. Considerable time during the year has been devoted to experiments with calcium cyanide to determine its value as a greenhouse fumigant. Numerous box and greenhouse tests were conducted in Washington to determine the range of safe dosages, and with this as a basis tests have been carried out under commercial conditions here and in the vicinity of Philadelphia. Results indicate that a one-fourth-ounce dosage is safe for use on rose, carnation, and several other crops. Experiments with nicotine fumigation have also been made to determine what concentration is necessary for the control of such aphids as *Myzaphis* sp. on rose and *Myzus persicae* on snapdragon. It appears that from 35 to 93 per cent higher mortalities of these insects can be obtained by using three times the recommended dosage. Nicotine dusts containing 2 per cent of nicotine were found decidedly effective in killing adult moths of *Rhyacionia frustrana bushnelli*. An unusual injury to a rose establishment by the Surinam cockroach, *Pycnoscelus surinamensis*, was reported. Work in the important field of greenhouse insects has been actively prosecuted during the year and results of much importance obtained.

CITRUS THRIPS

Investigations of the citrus thrips in California at the bureau's laboratory at Lindsay have been continued in cooperation with the Tulare County Citrus Growers' Exchange. Efforts have been directed to finding a simpler and more economical control for this insect than is now available. The varying severity of infestation by the insect from season to season interferes materially with the carrying out of a prearranged program of experiments. However, it has been possible to test every promising phase of spraying, such as winter applications, spring applications, as well as applications during both winter and spring. Some 125 acres of citrus groves were sprayed under the im-

mediate supervision of the laboratory, and results of this work will be ascertained at the proper time of harvesting of the fruit. The biologic studies of the citrus thrips are fairly well completed, though additional facts of importance have been added to information previously obtained.

FLORIDA CITRUS INSECTS

The work at the station at Orlando, Fla., has been somewhat enlarged by the transfer to it of the investigational work under way for some years at Miami, Fla., on insects attacking the mango, guava, avocado, etc. The work has been divided into two principal sections, namely, biological work and investigational work connected with control operations, including liquid and dust insecticides and the like. In the biologic field special attention has been given to the citrus aphid. Life-history studies of the insect have been made and information obtained on the duration of the various stages. The aphid has been found on many food plants, especially during the spring. An important hymenopterous parasite of the citrus aphid was unfortunately unable to maintain itself during the summer, partly on account of secondary parasites, but largely owing to the dwindling of the aphid population as soon as the citrus growth hardened. Many aphid colonies were wiped out by entomogenous fungi. Special inquiry relative to the predacious enemies of the aphid has been conducted in the laboratory to ascertain their rate of feeding, their life histories, and other facts possibly facilitating their usefulness. The studies have included four species of syrphid flies, two species of lacewings, nine species of coccinellid beetles, and a small agromyzid fly, *Leucopis americana*. Colored illustrations of all of these insects are being prepared for permanent record. In the insecticide field, investigations have been confined principally to experiments with sulphur and with various oils. The tests with sulphur have been designed to determine what form of sulphur will remain fatal to rust mites for the longest period of time and the factors which add or detract from this period of efficiency. This has included tests of various grades and brands of sulphur in determining the effects of sun, rain, humidity, and temperature on decrease of sulphur on the foliage. In the oil studies a number of oil emulsions have been prepared with various emulsifiers and it

has been found that the physical properties of oils vary with these, especially in viscosity and the size of the oil globules. In emulsions prepared with an excess of lime caseinate or kaolin there appears to be a slight reduction in efficiency of the oil against the purple scale and the Florida red scale. Further study will be necessary to ascertain the causes involved in this reduced efficiency. Oil shadowing on the fruit, it has been found, may be reduced by the employment of from 2 to 4 pounds of calcium caseinate to 100 gallons of diluted spray. Oils of the saturated and unsaturated series are being studied to determine if there is any correlation between the unsaturated compounds of oils and the toxicity of the oils to the foliage and insects. Highly refined oils and sulphonated oils have been used, and it appears that pure oils can be applied to foliage in greater concentration without injury than the dark lubricating oils. The centrifugal method of determining the percentage of oil in dilute and concentrated solutions as worked out by the Bureau of Chemistry is accurate for soap oil emulsion, but not so accurate in some of the emulsions prepared with other emulsifiers. With emulsions prepared with such materials as kaolin it will be necessary to work out a new procedure. Studies of the insecticidal value of coconut fatty acid for the citrus aphid were made during the year. Concentrations of 1 part fatty acid to 200 parts of water or less produced injury to the young growth of trees. Satisfactory aphid kill without tree injury was obtained with concentrations of 1 part fatty acid to 600 parts of water. Extracts of Derris root in sulphonated castor oil have shown great promise against the citrus aphid. This material has already been tried by several growers with satisfactory results.

VEGETABLE AND TRUCK-CROP INSECT INVESTIGATIONS

Work on the project of vegetable and truck-crop insects has been continued under the direction of J. E. Graf.

MEXICAN BEAN BEETLE

During the late summer of 1924 the Mexican bean beetle continued to spread rapidly in a northerly direction, reaching the shores of Lake Erie in the vicinity of Cleveland and extending its range along the lake al-

most to the Pennsylvania boundary. In addition there was considerable spread in northwestern Ohio. It appeared also in the counties in Indiana bordering on the Ohio River in the southeastern section of the State. The spread in West Virginia continued until the western half of the State was generally infested. The infested area increased slightly to the east and to the west. In North Carolina and South Carolina the beetle has now passed entirely beyond the main range of the Alleghenies and has invaded the coastal plain. In Virginia it has not yet succeeded in establishing itself east of the main range of the Alleghenies.

In the latter part of the summer of 1924 and the early summer of 1925 an unusually large number of reports of injury were received from correspondents. It appears that the injury has been heaviest in the Allegheny Plateau region which takes in eastern Tennessee, eastern Kentucky, West Virginia, and western Virginia and North Carolina. In southern Ohio the infestation increased rapidly during the summer of 1924 and the beetle caused heavy damage to beans that fall. The damage over the territory southeast of a line from Cincinnati to Ashtabula County was heavier than over the section northwest of that line. Near the southern end of the infested territory at Birmingham, Ala., and Newport, Tenn., the insect increased during the summer of 1924 and became very abundant in late June and July. It now seems that it is a more dangerous pest in the hilly and mountainous regions than in the plains regions.

Only minor changes in the insect's habits and life history have been noted. In the years 1922, 1923, and 1924 it appeared from hibernation later each year than in the preceding year, but in 1925 it changed its habits radically, appearing two and one-half weeks earlier than in 1924. This sudden change in habit may have been due to the hot, dry weather of the spring of 1925. In 1924 a maximum of three generations was produced, computing from the first eggs of the first beetles appearing, but in 1925 indications are that a maximum of four generations will be produced.

In 1924 the beetles were found in the woods preparing for hibernation as early as September 5, but later scouting showed that the number of beetles hibernating in woodlands was much lower than usual, only about one-tenth as many having been found

to each unit area as in the previous year. The survival in hibernation, however, was much higher than usual, 24 per cent of the beetles in a large hibernation cage having passed the winter successfully.

Results in control studies have corresponded very closely with those of previous seasons. Lead arsenate, zinc arsenite, and the lead arsenate-lead oleate mixture were all injurious to the bean foliage under southeastern conditions. One sample of magnesium arsenate proved to be too injurious to bean foliage to be of value, but the magnesium arsenate commonly found on the market, while poisonous to the insect, proved to be largely noninjurious to foliage. The calcium arsenate and lime mixture also proved its value as in the preceding years, although in some tests it has shown itself slightly more toxic to bean plants than the magnesium arsenate. A series of tests with the fluorides and fluosilicates indicated that some of these mixtures are promising insecticides, especially the sodium fluosilicate, which was recommended by Marcovitch, of Tennessee. It was found, however, in the preliminary experiments, that sodium fluosilicate was not so uniformly effective at high dilutions as magnesium arsenate or calcium arsenate. Experiments with these materials are being continued.

Laboratory tests of the chemotropic responses of the Mexican bean beetle have been completed with 96 aromatic chemicals. With the exception of three, all were found to be repellent to the bean beetle, and these three may possibly show some attraction.

Collections were continued during the year to determine whether the Mexican parasite introduced in 1922 and 1923 had become established. None have been recovered, and it is quite probable that this parasite was never successfully colonized. In 1924 only two specimens of the native parasite *Phorocera claripennis* were recovered, and in June, 1925, several larvæ bearing eggs of this parasite were collected. To date this fly has not shown any promise of controlling the bean beetle under field conditions.

During the present spring a substation of the Birmingham laboratory was established at Geneva, N. Y., where investigations on the Mexican bean beetle and other bean insects are being conducted in cooperation with the State experiment station.

Investigations in the West have been continued mainly along biological lines, since the extremely dry weather

of the last three years has curtailed bean culture there. Experiments to determine the factors affecting the insects in hibernation have shown that precipitation is important when the insect is about to emerge in the spring. It came out in greater numbers after even moderate rains. These experiments were checked by artificially watering hibernation cages in which large numbers of beetles were wintered. Flight tests conducted with marked beetles showed that the insects fly either up or down the canyons with the prevailing winds and that they use the canyons as migration paths, both in entering and in emerging from hibernation.

Experiments with arsenicals under western conditions have shown definitely that practically none of these materials is injurious to beans under arid conditions and at altitudes of from 6,000 to 7,000 feet.

PEA APHIS

Control studies on the pea aphid have been continued, both in Wisconsin and in California, in cooperation with the State entomologists and the canners' organizations. Results during the year were not conclusive in any of the districts, owing to the peculiar nature of the infestation. Under California conditions the use of nicotine dust, applied with a self-mixing duster, gave satisfactory control of the pea aphid, the highest killing being obtained with the 4 per cent nicotine dust applied at the rate of 50 pounds to the acre. Under Wisconsin conditions the highest killing obtained with nicotine dust was about 70 per cent, whereas the aphidozer collected an average of 82 per cent of the aphids from all of the field swept. Experiments with the aphidozer are being continued in the hope of improving it so that it may be used effectively under all field conditions, and especially where the plants are unusually large.

SWEET-POTATO WEEVIL

The sweet-potato weevil eradication campaign has shown consistent progress in Florida and Mississippi. In the former State, where the work is conducted in cooperation with the Florida State Plant Board, no infestation of the weevil has been found in the original test area in Baker and Charlton Counties. In the Lilly project in southern Florida no weevil was found during the inspections in Au-

gust, 1924, and January, 1925. In Mississippi only 15 farms have been found infested during the present year in Pearl River and Hancock Counties. The work in Mississippi has been changed to some extent in order that more attention may be given to the infested districts. The workers of the Bureau of Entomology were concentrated in the counties of Pearl River and Hancock, and the project in Jackson and Harrison Counties was taken over by the workers of the Mississippi State Plant Board. By dividing the territory in this way, it has been possible to visit the infested properties with greater regularity, and this fact was doubtless responsible for much of the progress made in the eradication campaign within this State.

In Alabama the situation has become serious, owing to the finding of several infested properties and some infested morning-glory in Baldwin County, one of the heavy sweet-potato producing sections of the State. Scouting, in cooperation with the Alabama State Department of Agriculture, has been begun on a larger scale.

The attempted eradication of this insect in all of these areas is a novel experiment. To exterminate a well-established insect without seriously interfering with the production of the crop on which it feeds is something new. These methods are possible owing to the slow dissemination of the insect. The methods are all cultural in nature and include field cleaning, careful storage of the crop, and the utilization of weevil-free planting stock. When these steps are followed carefully, there results a period of several weeks in early spring when any weevils which may have survived in the old field are without food. Experiments have shown that the sweet-potato weevil can live only for a few weeks without food during the spring, and since the adult is sluggish it does not normally go far in search of food. In cases where the new planting is made at some distance from the previous year's planting and all volunteer plants in the old field are kept down, the weevil is either greatly reduced or eradicated.

SUGAR-BEET LEAFHOPPER

During the year studies on the sugar-beet leafhopper were initiated in the intermountain region, with headquarters at Toppenish, Wash. During the preceding year the sugar-beet leafhopper had been unusually abundant throughout this area, and in

most of the large districts losses from curly-top, a disease carried by the leafhopper, were so severe that the tonnage was very materially reduced and in the Yakima Valley the culture of sugar beets was practically stopped. Investigations to date have consisted principally of biological and ecological studies of the leafhopper and of the factors responsible for the abundance and migration of this pest. Co-operative studies with the Utah and Idaho experiment stations have been begun, and the insect is being studied in the desert breeding grounds. During the present spring in the intermountain region practically no loss from the sugar-beet leafhopper has been noted, owing possibly to the rainy season and the fact that the desert breeding grounds of the insect have not dried up as early as usual.

POTATO AND TOMATO INSECTS

Potato leafhopper.—Experiments for the control of the potato leafhopper have been continued in cooperation with the Wisconsin Agricultural Experiment Station. These tests are now in their fifth consecutive year and will be continued for about two years more until the results under various seasonal conditions will be available and may permit definite recommendations. The indications at the present time are that when the infestation of leafhoppers is heavy, Bordeaux mixture spray, properly applied, is somewhat more effective than Bordeaux dust.

Australian tomato weevil.—Biological and control studies of this insect, which has now been definitely determined as *Listroderes obliquus*, have been continued. As yet no males have been discovered, reproduction occurring parthenogenetically. Only one generation of this weevil is produced a year, egg laying starting during the last days of September and continuing for several months. The earliest weevils appear in December, but none of these have been found to lay eggs until the following fall. During the year the insect has been found to exist over a wide territory, including 19 counties in southern Mississippi, 17 counties in southern Alabama, 2 counties in western Florida, and 8 parishes in southeastern Louisiana. Very little work has been done on the control of this insect, owing to its scarcity. Its numbers were greatly reduced by the cold weather of the two preceding winters.

During the spring of 1925 a closely related insect, *Listroderes apicalis*,

was found in several parishes in southeastern Louisiana. No information is available on the possible economic importance of the insect, but it is regarded with apprehension, since it is closely related to the Australian tomato weevil. Both sexes of the latter insect have been found.

Tomato suckfly.—The tomato suckfly was found during the year for the first time in the State of Mississippi. It is impossible to state just how serious this pest may become in its new environment, but it caused considerable injury in the small infested area under observation. This insect has been known as a serious pest of tomatoes in Texas for several years.

Seed-corn maggot of potatoes.—The seed-corn maggot as a potato pest was studied on a larger scale in North Carolina during the present season. Studies on the biology and habits of this insect show that the character of the soil does not largely determine infestation by the maggot, but that the insect is attracted by organic fertilizers, especially fish scrap, dried blood, etc. Where the weather is cool and dry during the early spring and the germination of seed potatoes is retarded, these insects may become serious pests, destroying a considerable portion of the seed before it has had a chance to germinate.

Tomato fruitworm.—Experiments on the control of the tomato fruitworm were conducted at Birmingham, Ala., and Baton Rouge, La. Experiments with arsenicals have given rather inconclusive results, except in a few instances. It is possible that arsenical treatment at a certain time either in the development of the insect or the crop will prove a successful remedy, but from the present information it is impossible to recommend a particular time. In some plats which received two applications when the largest fruits were about half grown and when the oldest fruits were nearing maturity, the infestation was reduced about 50 per cent. Experiments conducted in New Orleans indicated that sweet corn is worthless as a protective trap crop for tomatoes.

ONION INSECTS

Onion maggot.—Tests with the cull-onion method for trapping the onion maggot have been continued. Preliminary results indicate that the adult flies are strongly attracted to the early planted culls and deposit a large proportion of their first-generation eggs on them. In one experiment

246,000 insects were trapped on a row of cull onions one-fourth of a mile in length. Experiments in killing the various stages of the insect in the cull bulbs have shown that from 80 to 90 per cent of them may be killed by treating the cull row with cheap oils, such as road oil or crank-case drainings. Preliminary experiments planned to determine optimum arrangement of plantings of culls to obtain the maximum of protection will be completed later in the year.

WIREWORM INVESTIGATIONS

Studies on the biology and control of the western cultivated-land wireworms are being continued in Washington State and California. Indications are that the wireworms winter at an average depth of about 10 inches, and although the ground froze to greater depths than usual these worms, as well as the adults, in winter cells from 5 to 8 inches below the surface appeared to be uninjured by the cold. The wireworms work toward the surface and begin feeding early in March, thus becoming active early enough to injure seeds and seedling stocks. The first adults appeared early in April and the first egg laying was noted May 7, young wireworms appearing late in the same month. Experiments with soil fumigants have shown that the wireworms can be killed with either calcium cyanide or carbon-disulphide emulsion, but that the gases do not diffuse far in killing concentrations. Promising preliminary results have been gained by using baits to concentrate the wireworms and then following this by treating the concentration rows with soil fumigants. Injury to growing crops resulted from many of these treatments, but this may be overcome by treating the soil a short time in advance of planting. Complete meteorological records are being maintained as a check on all biological records.

PHYSIOLOGICAL INVESTIGATIONS

During the year studies have been conducted for the determination of the respiratory metabolism that takes place during embryonic development, histolysis, and pupal development of insects. The results of this study, which are considered significant and of fundamental importance in insect transformation, were published recently. The investigations have been broadened to include a study of the

toxicity of arsenicals and their effect on respiratory metabolism in the hope that a convenient laboratory method may be discovered for the determination of the toxicity of arsenicals on different insect species and thus make it unnecessary to conduct large-scale field tests for the preliminary toxicity and control investigations.

MISCELLANEOUS INSECTS INJURING VEGETABLES

Twelve-spotted cucumber beetle.—Biological and control studies on this insect are being conducted in Louisiana. Useful observations have been made on plants attractive for oviposition, but it has not yet been determined what becomes of the first-generation beetles under field conditions shortly after they appear. They have been noticed to feed for a short period, but soon leave the fields. In the laboratory two generations of the insect have been reared. Control tests on a small scale have indicated that undiluted sodium fluosilicate dusted on the beetles kills a very large proportion of them. Less satisfactory control results where the beetles are placed on dusted plants. Dilution of the sodium fluosilicate with lime materially reduces its effectiveness.

Blister beetle (*Epicauta lemniscata*).—Outbreaks of this insect were treated with various baits and insecticides. Used alone, the arsenicals were of little value, but when calcium arsenate was mixed in equal proportions with sodium fluosilicate good control resulted. Sodium fluosilicate used alone was also effective, but the use of both this material and the calcium arsenate-sodium fluosilicate mixture resulted in some plant injury.

Mole crickets.—Studies on the Porto Rican mole cricket in the Southeastern States have been broadened to include its control on golf courses and lawns. Applications of the baits which proved so successful against this insect under cultivated field conditions have again demonstrated their usefulness, especially against the young. Soil fumigants have given good control of adults, but the dosage has not been worked out to a point where they are absolutely safe to use in grass plots.

Pepper weevil.—Biological and control studies are being continued on this insect in southern California, where several extensive infestations were recently discovered. Injury in the infested fields has again varied between 10 and 100 per cent of the

crop. Cultural control consisting of clean culture immediately after harvest followed by early plowing has given the best results.

SOUTHERN FIELD-CROP INSECT INVESTIGATIONS

W. D. Hunter has continued in charge of these investigations.

COTTON BOLL WEEVIL

The use of calcium arsenate dust for boll-weevil control has continued to become established more widely as a standard farm operation, particularly in those sections of the South suffering the greatest weevil damage. For the last several years the bureau has made steady progress in improving the methods of utilizing this poison; both the poison and the machinery have undergone changes and improvements in quality as well as reductions in price, and the spread into new territory has of course necessitated many modifications in the methods of application.

The cotton season of 1924 was peculiar in that a very light emergence of weevils in the spring was followed by a phenomenal drought which to a very considerable extent controlled the weevils over a large portion of the Cotton Belt. For this reason it was not possible to conduct plat tests, as has been done in past years, particularly at the Tullulah, La., station; however, this did afford an opportunity of checking many of these experimental methods under conditions of light weevil infestation, and the heavier infestation at the station at Florence, S. C., afforded a valuable contrast.

Extensive studies, both chemical and entomological, were continued concerning the suitability of different types of calcium arsenate. In the same series approximately 300 new suggested remedies for the boll weevil were tested, much of this work having been done in cooperation with the Federal Insecticide and Fungicide Board, and where there was evidence of deliberate attempt at fraud the board was assisted in the preparation of evidence for use in prosecution.

Very important progress has been made in the use of airplanes for distributing poison. The experimental work of the past was carried to the point where commercial organizations have now undertaken this operation on a commercial scale. Of course much research work has been neces-

sary to obtain the information desired as a basis for such a commercial operation, and although there is still much to be learned, commercial activities have progressed to a point where it is shown quite definitely that airplane poisoning will be a success not only in the control of cotton insects but also for use against many other pests. During the cotton-growing season of 1925 something over 50,000 acres of cotton were poisoned commercially with airplanes, and it is evident that this area will be greatly increased within the next few years. Great progress has been made in the development of special planes for cotton dusting and in the testing of these planes, looking toward their still further improvement in the future. Studies have been conducted on the best methods of flying, the different dusting problems encountered, and on the selection of the most suitable dust for these various conditions.

In connection with these airplane studies additional observations have been carried on for the purpose of applying the principles of airplane dusting to the operation of ordinary ground machinery. Several new types of dusting machines are in course of development, and some of these have been carried to the point where they will very soon be ready for commercial production. These machines are designed particularly for operation under conditions where the older types could not be used, and especially good results have been obtained from daylight operations with them as contrasted with those obtained with the older types. The studies on the electrical charging of dust particles have been continued in the same series in cooperation with the Bureau of Standards.

Very important progress is being made on the chemical attraction of the boll weevil. The investigations of the Bureau of Chemistry on the chemical constituents of the cotton plant are now completed and two promising chemicals have been located, both in the plant and in the emanations from the plant, thus indicating that they stand the greatest chance of furnishing the odor which attracts the boll weevil to the cotton plant alone. Apparently tests of these chemicals show that they are attractive to the boll weevil, and these investigations are being continued for the purpose of determining whether or not this attraction can be increased to the point of commercial benefit.

Special attention has been devoted to the hibernation of the boll weevil. During the last 10 years the Tallulah laboratory has been making an intensive study of hibernation observations for the purpose of determining the possibility of predicting weevil abundance some time in advance. In 1924 it was decided to attempt to apply on a very extensive scale the principles learned in this study, and a cooperative series of tests was started, under which about 10 of the different State experiment stations reported to the Tallulah laboratory observations on weevil hibernation at biweekly intervals. These were immediately summarized, interpreted, and issued for the benefit of the farmers. This preliminary test was so successful that arrangements have been perfected for a much more extensive series during the coming season.

The cooperative station at Florence, S. C., has been continued along the lines originally planned. Various control measures have been given a rather thorough test under the conditions of the Southeastern States and a progress report on the results of these has been issued as Bulletin 223 of the South Carolina Experiment Station. At present particular attention is being devoted to the biological phenomena under these new conditions with the idea of determining exactly wherein the behavior of the weevil differs from that at points studied in the past, so that this information may be utilized in outlining suitable control measures.

OTHER COTTON INSECTS

The interrelationship between boll-weevil control and plant-louse damage to the cotton crop has been given more intensive investigation than ever. Methods of control, both direct and indirect, have been carried to a fairly satisfactory point, although much improvement is still expected.

The increased interest in the Arizona wild-cotton weevil brought about by its appearance on cultivated cotton at Tucson, Ariz., has made it necessary to open a permanent station in Tucson for the purpose of studying this insect with particular reference to its possibilities of damage to the western cotton crop and the means of preventing such injury.

The cotton "hopper" or "flea" has apparently been increasing somewhat in the spread of its activities, and intensive studies on its control are being

carried out along the Gulf coast of Texas. In addition, observations are being conducted in all cotton States to determine the exact extent and severity of its injury. Strong indications were found that this insect transmits a disorder of the cotton plant. The plants shed practically all of their fruit and grow abnormally tall. Such damage has occurred for a number of years in southern Texas, but in 1923 it occurred in northern Texas and in several of the eastern States in the Cotton Belt. Grave fears arose among the planters that the pest would be as important as the boll weevil. The studies included the relations between outbreaks and climatic conditions and experiments in control. It was found that flowers of sulphur is a much more effective agent in killing the insect than any of the other numerous materials tested. The indications are that methods of using sulphur on an economic and satisfactory basis may be devised.

The cotton leafworm has been increasingly active for the past several years, and a series of studies has been started for the purpose of working out improved means of predicting outbreaks of this pest, as well as the best methods of handling such outbreaks.

TOBACCO INSECTS

The green June beetle continues to be a pest in the plant beds that are used for more than one season. The remedy worked out last season has given satisfactory control and the recommendations for its use will shortly be published.

In the Burley tobacco region about Lexington, Ky., wireworms caused damage to the tobacco running into the hundreds of thousands of dollars. Losses of 10 per cent are not uncommon. An average reduction of the beetles, amounting to 71.8 per cent, was obtained in 1925 by the use of sodium fluosilicate as a bait poison at a cost of about 1 per cent of the value of the crop. This is a decided gain over the control of 55 per cent obtained with Paris green in 1924 and 1925. One application of the bait has increased the crop stand from 2 per cent in a light infestation to as much as 12 per cent in heavy infestations. It has also greatly reduced the main damage to the crop which is due to the stunting of the plants attacked.

In the dark-tobacco belt of Virginia the tobacco Crambus is a pest of major importance. In years of severity the loss amounts to from 15 to 20

per cent of the crop, totaling more than \$1,000,000; in years of comparatively light infestation it amounts to about 5 per cent of the crop, totaling about \$375,000. This loss is brought about by infestation of early settings, necessitating several replantings, the first of which may be an almost complete resetting, and the result is a reduction in yield and quality. At the Virginia Tobacco Experiment Stations at Chatham and Appomattox the annual loss has been estimated at about 14 per cent. Experiments at Appomattox in the spring of 1925 resulted in a reduction of 55 per cent of the infestation by one application of a trap bait which was applied at a cost of about 1 per cent of the value of the crop. This problem is of major importance and demands further experimentation.

The control measures for the tobacco budworm on cigarette types of tobacco, which were perfected in 1924, were brought into general use in the spring of 1925 through circulars addressed to growers, through newspaper articles, and through the cooperation of the county agents in the districts where this type of tobacco is grown. The result was a saving of many thousands of dollars to the growers.

SUGARCANE AND RICE INSECTS

The year has seen an awakening among the Louisiana sugar planters in matters pertaining to agriculture and insect control. The attention of the planters was called by the bureau to the value to the soil and to the control of the sugarcane moth borer in not burning the "trash" or cane leaves left after cutting the cane. Plowing this material under in a certain manner was recommended. This practice is at last being rather widely adopted, though the recommendation was first made a number of years ago. It was also pointed out that the borer multiplies rapidly in cornstalks, and the curtailment of corn planting or the isolation of cornfields from sugarcane fields was advised. Although it is unlikely that corn planting has been curtailed, several planters have made an effort to plant the corn in blocks separated as much as possible from the fields of sugarcane.

It was found that soaking the seed cane before planting in water of ordinary temperatures for 72 hours destroys all borers in the cane. This is very important, as it is evident that the planted seed cane provides the principal place of hibernation for the

borer, the moths emerging through the soil in the spring. One planter tried this on a small scale, and then treated practically all his seed cane. Barges were filled with cane and then pumped full of water. The germination of the cane was stimulated, and as less cane was used for planting, because no allowance had to be made for borer injury after planting, the owner of the plantation estimated that the treatment cost nothing at all. A degree of control was also obtained against the sugarcane mealybug by the use of the water treatment.

This bureau again cooperated with the Bureau of Agricultural Economics in estimating the loss in Louisiana due to the ravages of the moth borer in sugarcane. Our estimate in 1924 was that the borer had destroyed 13 per cent of the crop, or caused a loss of about \$3,500,000. In 1923 the loss was estimated at 23 per cent. In these estimates no account is taken of the damage suffered by corn.

Cooperation was arranged with the newly formed Tropical Plant Research Foundation, which has a number of specialists studying sugarcane problems in Cuba.

Studies were begun on sugarcane insects of minor importance, with special reference to the transmission of mosaic disease.

It was found that the Cuban tachinid parasite, introduced from Cuba in 1919 and 1920, is still in existence in Louisiana, though very rare. It is possible that in the course of time this parasite may become an efficient factor in the control of the sugarcane moth borer.

Experiments in controlling the sugarcane mealybug in the sirup-producing section around Cairo, Ga., were continued. Some success was obtained.

A comprehensive manuscript on rice insects and their control, not only in Louisiana but also in Arkansas and California, is almost ready for publication.

Soybeans are being adopted as a rotation crop on rice plantations, where fields not planted in rice have been allowed to grow up in grass and weeds instead of being planted in some other crop; so attention has been paid to the principal pest of soybeans—one of the blister beetles. A perfect control measure has been found in dusting the plants with sodium fluosilicate. This poison is cheap, and it is necessary to dust only the part of a field where the beetles actually occur. Dead beetles have

been found over 100 feet from the place where the poison has been applied.

INVESTIGATIONS OF INSECTS AFFECTING THE HEALTH OF MAN AND ANIMALS

The investigations relating to the screw-worm problem in the Southwest were continued throughout the year. The work looking toward the development of repellents for the protection of wounds from infestation, which is being carried out in cooperation with the Bureau of Chemistry and the Texas Experiment Station, received major consideration. Many of the materials found by jar tests to be effective in repelling the screw worm and other flies were tested on living animals which were infested with screw worms. Much valuable information on the reaction of the screw worm fly and the treated wounds to various materials was obtained. This work is of a complicated nature, requiring numerous repetitions, and hence is still incomplete, although some of the more promising repellents are being recommended to the stockmen.

Experiments were being continued with sprays designed to kill and repel the horn fly, stable fly, and house fly on cattle. Special attention was given to various Pyrethrum extracts which are promising as fly destroyers. Tests were also begun to determine the proper bases for sprays for use on livestock. This work is being done in cooperation with the Bureau of Chemistry.

Large sums are being spent in the aggregate for materials which are claimed by the manufacturer to destroy lice, mites, ticks, and other external parasites of poultry when administered to the fowls in feed or water. It was therefore deemed necessary to carry out further experiments, begun last year, to determine whether the chemical compounds usually contained in these so-called remedies or, in fact, any others will destroy or repel such external parasites. Several series of such experiments were carried out during the year. It was found that none of the materials administered to the fowls gave control of such parasites as the chicken lice, chicken mite, scaly-leg mite, fowl tick, and sticktight flea, even though used in large doses. Furthermore, many of the substances administered were deleterious to the fowls.

For several years physicians in the Southeastern States, especially in

Florida, have urged the bureau to undertake an investigation of the human malady known as creeping eruption. An investigator of the bureau undertook preliminary investigations of this common yet little understood affliction during the summer of 1924. The work was carried on in close cooperation with J. L. Kirby-Smith, of Jacksonville, Fla., and the Florida State Board of Health. Substantial progress was made during the summer of 1924 on the epidemiology and treatment of the disease, and numerous specimens were excised from several patients. These specimens were sectioned and given careful microscopic study during the winter, with the result that four specimens of the causative parasite were discovered. These proved to be larval nematodes instead of insect larvæ, as was generally supposed heretofore. Whether insects are concerned in any way with the development and spread of the worm, whether it is a parasite of some higher animal or whether it is a free-living species accidentally attacking man, remain to be determined. A progress report on these studies was presented before the American Medical Association and will be published in the journal of that organization.

The field studies at Mound, La., on the biology, distribution, and seasonal behavior of *Anopheles* mosquitoes were continued. A general report on the types of breeding places found in this locality and the natural conditions affecting mosquito breeding was published, and an investigation of the number of malaria mosquitoes produced per unit of area was completed.

Further tests were made to determine the feasibility of distributing larvicides over large areas by means of airplanes. The final tests made in 1924 were very successful, over 99 per cent of the larvæ in an area of about 40 acres having been destroyed in one of the applications. The dusting of a flooded rice field with a heavy stand of half-grown rice and abundant *Anopheles* breeding demonstrated that the larvæ could be readily killed under these conditions and that such fields were well adapted to airplane treatment. The quantity of Paris green used in places where the protective vegetation was not more than a few feet above the water surface averaged about one-half pound per acre, but the quantity was considerably increased where the water was protected by willows and larger trees.

In May, 1925, *Anopheles* control by airplane was undertaken on a unit in which the breeding areas at the time totaled about 800 acres. This experimental control project was designed to provide data as to the frequency of applications, range of flight of the adults, percentage of control possible, costs of operation, etc.

Several commercial concerns have become interested in the development of improved larvicides and a large number of toxicity tests are being made on these and other materials. Some progress has been made on the production of dry larvicides which have been treated so as to float on the surface of the water.

In chemotropism studies considerable effort has been made to develop a suitable technique for the handling of mosquitoes in such work. The attractive qualities of a series of substances have been tested out, but those tested with *Anopheles* have been almost entirely negative or without effect.

The cooperation with the School of Hygiene, of Johns Hopkins University, on the host preference of *Anopheles* was continued, and a series of mosquito stomachs containing blood was sent to Baltimore for the identification of the blood by means of the precipitin method. In a small number of specimens of *Anopheles punctipennis* no human blood was identified, thus supporting the previous findings with this species.

INVESTIGATIONS OF INSECTS AFFECTING FOREST RESOURCES AND SHADE TREES

F. C. Craighead has continued in charge of these investigations.

One of the more important activities of the year has been the development of closer cooperation with the Forest Service experiment stations. Although funds have not been available for maintaining activities in this field, by restricting certain older projects, entomologists have been detailed to three of these experiment stations during the period of insect activity. It has thus been possible to make considerable advances and initiate certain major projects which later will greatly expedite progress.

DEVELOPMENTS IN COOPERATION WITH THE FOREST SERVICE EXPERIMENT STATIONS

Continued progress has been made at the Lake States Forest Experiment

Station under the direction of S. A. Graham. Reports on certain phases of the spruce budworm and jack-pine sawfly have been published. An important new investigation has been undertaken involving biological studies and the possibilities of control of the serious tip-moth infestation in the Forest Service plantation at Halsey, Nebr. Parasite introduction will be an important feature of this problem. Several thousand parasites, representing 12 or more species, will be liberated.

Cooperation with the Northeastern Forest Experiment Station at Amherst, Mass., was begun late in the year. Certain timberland owners in Massachusetts have donated \$2,500 annually for the next two years for investigations of the white-pine weevil, and R. T. Fisher has offered the facilities of the Harvard Forest at Petersham. Further cooperation is expected from several State forestry departments interested in these studies. The main feature of this problem will be a survey of plantations in second-growth stands from Pennsylvania northward into Canada to determine if possible the factors producing immunity of certain stands. Age, rate of growth, density, species mixtures, site, and location will be some of the factors analyzed. Some time will also be devoted to a study of the entomological aspects of slash (in cooperation with the experiment station and Bureau of Plant Industry) and a study of the larch sawfly.

Field headquarters were established at the Appalachian Forest Experiment Station, Asheville, N. C. E. J. Kraus, of the University of Wisconsin, will devote part of the summer to certain aspects of the work relating to plant physiology. Pine problems, the results of studies of which should be applicable to the coastal plains as well as to the Piedmont region, will receive chief attention. The insects concerned are the bark beetles *Dendroctonus frontalis*, *D. valens*, *Ips avulsus*, *I. grandicollis*, and *I. calligraphus*. The investigations here, which will be of a more detailed character than anything previously undertaken, will consist in an attempt to analyze the environmental factors governing bark-beetle epidemics, and the relation of the condition of the tree itself to bark-beetle attack and brood development, particularly the effects of drought. Several observation stations are being established for comparison of the climatic and soil conditions, sap density, and moisture

content of the trees in two contrasting forest types—one where bark-beetle epidemics originate, the other where bark-beetle outbreaks never occur. This is a joint study involving other projects of the Appalachian experiment station. The part insects play in the death of fire-scorched and turpentine timber and the relation of insects to oak reproduction will also receive some attention in connection with Forest Service studies on other aspects of these problems.

During the winter plans broadening the scope of the western pine bark-beetle investigations were outlined in cooperation with the Forest Service research branch of district 5. These projects involve investigation of the relation of bark-beetle epidemics to various types of forest and timber stands of differing vigor. These studies have as their objective the possibility of improving timber sale regulations so as to reduce losses from bark beetles and secure prevention of losses through good forest management.

INVESTIGATION AND CONTROL OF WESTERN BARK BEETLES

At the western stations the bark-beetle problems have continued to be of the most importance, the chief work consisting of the survey and analysis of the results of large-scale control projects, experimental control on smaller areas, and biological studies. It is more and more evident that each of these destructive species of bark beetles constitutes a problem in itself and that general recommendations applicable to one species may not be suitable for another, or for the same species in a different forest or region. The status of the infestation (i. e., whether epidemic or endemic) likewise affects results. Much progress has been made during the year in gaining a clearer understanding of the possibilities and limitations of control and consequently in improving recommendations to other governmental agencies and private owners.

The San Joaquin project.—This project, initiated in 1919, has now been brought to a close. Direct control measures have been carried on against an endemic infestation of the western pine beetle which was killing annually less than 0.5 per cent of the volume of yellow pine, with the object of determining (1) whether endemic losses of this nature can be reduced, (2) whether increases starting from endemic infestation can be checked or prevented, and (3) whether the stump-

age value of timber saved by such control measures will warrant the cost of the work.

J. M. Miller, in charge, has summarized the results as follows:

1. By working an area with small crews so as to treat the more accessible infested trees it was possible to eliminate from 20 to 50 per cent of the seasonal infestation at a cost of from 4 to 12 cents per acre. This work, however, had little apparent effect in reducing losses or preventing increases.

2. By working an area intensively throughout the season with the object of treating all infested trees it was possible to eliminate about 90 per cent of the seasonal infestation at a cost of from 32 to 45 cents per acre. This method was carried out on a relatively small area of 3,600 acres. The losses were held down to about 48 per cent of what would have occurred if the increase had been in proportion to that on adjoining check areas where no work was done.

3. Intensive maintenance work is apparently the only method that will secure results, but in order for the cost of such work to be warranted by the value of the timber saved stumpage values will have to range from \$7 to \$12 per thousand. As present values on this area are about \$3 per thousand, the work was carried on at a loss. There are certain intangible benefits to be reckoned, such as added fire protection and elimination of snags, but under present values it can not be claimed that these additional benefits are sufficient to compensate for the loss on the control work.

These results will modify the policy that has been previously advocated in the control of this beetle. Heretofore control work has been considered warranted if directed against an infestation in accessible timber when any aggressive tendencies were noticeable, even though losses were low. Unless less expensive methods can be evolved control work under present stumpage values of yellow pine in this district can not be applied to advantage except where relatively high epidemic losses prevail. With losses as high as 1 per cent of the stand and stumpage values in excess of \$3.50 per thousand, a saving can be effected by direct control methods.

The southern Oregon-northern California project.—Results in controlling epidemic infestations are more promising and economically justifiable as exemplified by the southern Oregon-northern California project. The three-year program directed toward the control of the western pine beetle over this area of 1,000,000 acres, which was started in 1921, was brought to a close in 1924. This work was carried out cooperatively by the Forest Service, the Indian Service, and over a thousand private owners under the technical supervision of this bureau. Before the project was started the

western pine beetle was found to be destroying 120,000,000 board feet of merchantable yellow pine each year, having killed 10 per cent of the stand in the last 10 years. During the period of the work 32,000 yellow-pine trees containing 35,000,000 board feet of merchantable lumber, which had been killed by the beetles and still contained the live broods, were felled and the broods destroyed by burning the bark. The total cost of this work was \$145,000. A recent survey shows that since the control work started the annual timber loss has been reduced by 50,000,000 board feet per year which, at the present value of stumpage in this region, means an annual saving of from \$150,000 to \$200,000. To prevent recurring epidemics of the western pine beetle continued watchfulness must be maintained and control measures instituted whenever the beetle shows signs of assuming an epidemic status.

The Kaibab control project.—This project, directed toward the control of the Black Hills beetle on the Kaibab Plateau in northern Arizona, was continued during the year in cooperation with the Forest Service and National Park Service. This outbreak, first noticed in 1920, increased in severity during the next few years, destroying 25,000,000 board feet in the season of 1923 alone. In 1924 \$35,000 was spent on the national forest and the Grand Canyon National Park in the control of this insect. Over 28,000 trees which had been killed by the beetles were treated. A survey made in the fall of 1924 showed that this represented less than half of the infested trees, but where the control work was instituted the progress of the infestation was halted, at least temporarily, and considerable timber saved from destruction. On these treated areas a reduction in infestation of 50 per cent was obtained. This was lower than was anticipated and probably the almost rainless summer greatly influenced the results. This project will be continued for another year at least.

The Deerlodge and Bitterroot National Forests, Mont.—The Forest Service and Bureau of Entomology have agreed on tentative plans for conducting a large-scale project against the mountain pine beetle in an effort to protect the valuable lodgepole stands in the Deerlodge and Bitterroot National Forests in Montana. An outbreak developing in the Clearwater drainage in 1909 has been continuously progressing ever

since in out-of-the-way regions. The total quantity of timber killed has been enormous, but since it was largely inaccessible it was felt that control measures were not warranted. This infestation has now crossed to the east side of the Continental Divide on the above-mentioned forests and merchantable timber is threatened. Some \$6,000 will be spent this year and the operations will be enlarged next season. Besides the protection obtained, this project will yield valuable data regarding this insect and the technique in fighting it.

AIRPLANES USED IN BARK-BEETLE SURVEYS

During the latter part of the year tests were made to determine the practicability of using airplanes in locating bark beetle-infested trees on the national forests. Through cooperation of the War Department a plane was dispatched from Crissy Field, San Francisco, Calif., to certain bark beetle-infested areas on the Sierra National Forest. An observer was carried and photographs taken of nearly 20 square miles of timberland. A much clearer idea of the distribution of the infestation was obtained and the infested trees were readily located on the prints obtained. The preliminary results are very encouraging, but further tests will be needed before the practicability of this method in comparison with the laborious ground surveys can be fully determined. If the costs are not excessive it promises great advantages.

ENTOMOLOGICAL ASPECTS OF SLASH DISPOSAL

This important question has received continued attention and the results of several years' experiments and general studies in Oregon and California have been compiled for publication. It has been demonstrated that pine slash in this region is not a menace to surrounding timber in affording breeding material for the multiplication of injurious bark beetles. This is due to the high mortality of the developing broods.

INTERRELATION OF INSECTS AND FIRE

The results of these studies will be submitted for publication by the department in the near future. Contrary to the generally prevailing opinion, it has been found that, although fires in the yellow-pine forests of California *do* concentrate bark beetles on the area and thus increase losses, they do not serve as centers for building up infestations.

DEFOLIATING INSECTS

The most important outbreaks of defoliating insects occurred in the Yellowstone National Park. A new species of sawfly and a needle tyer, *Argyrotaenia* (*Eulia*) *pinitubana* Kearfoot, were involved which together have killed some 25 square miles of lodgepole pine. A lighter infestation exists over an area of 100 square miles. No wholesale control methods were possible, but along one of the main highways crossing this belt arsenical sprays were used with excellent results. The spruce budworm infestation still continues in the Yellowstone National Park and now threatens an area of great scenic value visited by large numbers of tourists. Experimental spraying will be conducted in the hope of at least saving roadside trees and those about camping grounds. Several square miles of Douglas fir have already been completely killed. Studies on the Monterey sawfly have continued. The present distribution of the Pandora moth in Oregon and California has been definitely determined. The defoliated area in Oregon covers approximately 300,000 acres, resulting in a serious reduction of the timber resources of the region. In epidemic centers the trees are almost entirely stripped of their foliage. This evidently lowers the resistance of the trees, with the result that they become an easy prey to bark beetles. The losses from this combined attack on a portion of the area has, within the last two years, increased from a negligible quantity to 10 per cent of the stand.

THE EUROPEAN PINE-SHOOT MOTH

During the spring of 1925 another survey was made to determine the present status of the European pine-shoot moth. This insect, which has been regarded as one of the most serious forest pests in Europe, has been established in this country for 12 or 13 years. In 1914 its status in the United States was thoroughly investigated, and recent examinations indicate little change in the situation. It is still present on certain private estates and nurseries in New York and Connecticut, but no evidence indicating its spread to natural pine stands has been found. The owners of these infested trees are cooperating in control. There is a serious potential menace in this situation, and steps are being taken to prevent the insect from becoming established in native timber stands.

TIMBER LOSSES IN THE SOUTHERN PINE BELT

Toward the end of the extreme drought which occurred over portions of eastern Texas, Louisiana, and Mississippi in the summer and fall of 1924 numerous reports were received describing quantities of dying pine infested with bark beetles. Expert investigation showed that over 100,000,000 feet of longleaf and loblolly pine was dead or dying, attacked by several species of Ips. It was finally concluded that the unusual drought was the primary cause of this mortality, though the losses were possibly increased by the attack of these beetles. Observations in the spring and summer after the resumption of nearly normal precipitation showed the situation relieved and the bureau's conclusions justified. Turpentine interests in this region were greatly concerned, owing to the extremely heavy losses in the timber which they were operating. The bureau's recommendations urging prompt salvage of the infested trees and advising against direct-control operations undoubtedly saved thousands of dollars.

INSECTS AFFECTING FOREST PRODUCTS

Tests of wood preservatives for both crude and finished forest products, as well as poisons for wood-pulp products, have been continued, both at Falls Church, Va., and on Barro Colorado Island, Canal Zone, Panama, by T. E. Snyder. Several coal-tar oils, sodium fluoride and other salts, various metal sprays, etc., are recent additions to these tests. An inspection of the tests located at Falls Church, Va., after 12 years' service, indicated that a coal-tar creosote with a high naphthalene and normal tar-acid content was more effective than one with normal naphthalene and high tar-acid content. The "full-cell" cylinder pressure process with such a coal-tar creosote is the most effective treatment so far tested for wood in contact with the ground. A lively interest is being manifested in these tests of wood preservatives by commercial firms in the United States as well as in other parts of the world. Officials of the Army, Navy, and aircraft services have recently sought this bureau's cooperation in efforts to clean up hardwood stock damaged by *Lyctus* powder-post beetles at their storage depots. Assistance has also been requested in writing out specifications for the future purchase of hardwood stock, by

following which such damage will be prevented. The Ordnance Division of the War Department in the future will insist on a linseed-oil treatment for implement-handle stock. Special efforts have been made to induce city engineers to modify building regulations slightly, so that damage by termites will be prevented. Approximately 150 requests per year are received from all over the United States for assistance in remedying termite damage to buildings and their contents; of course, this represents only a small proportion of the actual damage. In the experiments conducted in cooperation with the Bureau of Standards in spraying metals on wood infested with the California lead-cable borer all of the metal coatings except copper and brass were penetrated. The factor of hardness of the coating that resulted from the spray did not seem to be the determining element of effectiveness against this borer.

A moving picture entitled "Board feet or bored timber" has been taken by the motion-picture laboratory of the department. The use of this film, and the publication of an illustrated manuscript just completed describing various types of insect defects in wood and methods of preventing them, should be of great educational value and help to manufacturers and should result in the prevention of some of the \$40,000,000 annual loss by insects to forest products.

Studies of the biology and classification of termites, particularly American species, have been continued and extensive additions made to the collection which is now one of the best in the United States.

INSECTS AFFECTING SHADE TREES AND HARDY SHRUBS

The demand for information on insects of this class continues to increase, requiring further concentration on disseminating information. However, some experimental work has been conducted on the control of the boxwood leaf miner and the introduction of a dipterous parasite (*Erynnia nitida*) of the elm leaf beetle, from France, has been attempted. A general survey by questionnaires was made to determine the susceptibility of various tree species to insect injury in the different regions of the United States. Information on the insects affecting bamboo in the United States was brought together and published as a part of Department Bulletin 1329.

BEE CULTURE INVESTIGATIONS

The work of the bee-culture laboratory, under the supervision of James I. Hambleton, has been continued along the same general lines as formerly. The laboratory and experimental apiary are located at Somerset, Md., near Washington.

BEHAVIOR OF BEES

The brood-rearing work begun in 1921 is still being continued on one colony to determine the longevity and the lifetime brood-rearing activity of an individual queenbee under normal apiary conditions. Department Bulletin 1349, based on data obtained in 1921, is in press. The necessarily slow work of computing the later data obtained is progressing satisfactorily.

During the present season active experimental work on queen rearing has been taken up and a method has been devised for introducing queencells and having them accepted with the expenditure of less labor and with fewer bees per cell than is the case with certain methods now commonly used. The perfection of this method should result in the production of queenbees at considerably reduced cost.

The investigation of the responses of colony activity to changes in external temperature, humidity, and other factors, begun in the summer of 1921, was continued during the months of May and June, under artificial honey-flow conditions, and constituted a check on previous work. It is hoped that sufficient data are now at hand to complete this investigation. These data are now being computed.

A sequel to an investigation completed last year, the results of which will shortly appear as Department Bulletin 1339, "The Effect of Weather Upon the Change in Weight of a Colony of Bees During the Honey Flow," was conducted during the months of May and June at a temporary station established on the Delaware coast. This investigation dealt primarily with the effect of weather factors upon the flight activities of the honeybee. The data obtained are now being computed. The work was conducted with the cooperation of the United States Coast Guard.

Experiments are being made to ascertain the reactions of bees to intensities and colors of light. Previous work of this nature has not taken the intensity of color sufficiently into account to determine positively whether bees see colors as normal humans or as color-blind humans. In this in-

vestigation an attempt has been made to cause bees to associate intensity of light with food. Thus far results have been largely negative. The use of different colors has not yet been tried. These experiments should throw some light on the old question of the relation of flower colors to insect visits, and also upon methods for the successful lighting of bee cellars.

Department Bulletin 1328, "The Flight Activities of the Honeybee," has appeared during the year and has been the cause of much comment, as it was found that the amount of work performed by the individual bee is much less than was commonly supposed.

The study of the colors of American honeys, begun in 1922 in cooperation with the Bureau of Agricultural Economics, has been continued during the present season. In the last annual report mention is made of a number of difficulties encountered in perfecting a satisfactory grader, based on the color analyses of several hundred American honeys, but attention was called to the fact that all the difficulties had apparently been overcome and that an announcement of the perfection of a satisfactory grader was shortly expected. Since that time other difficulties have been encountered, the principal one being to find a medium of permanency to carry the correct color and turbidity of honey.

Finally, in cooperation with A. H. Pfund, of Johns Hopkins University, a satisfactory grader has been perfected which embodies all of the features desired in a honey-color grader. The principal feature of this grader is a wedge-shaped vessel for containing the sample of honey to be analyzed, combined with an inversely placed wedge of amber glass. The two wedges are viewed simultaneously through a slit by means of light transmitted from the rear. When the color of the honey and that of the glass wedge match, the color grade of the honey is indicated on an appropriate scale calibrated for the commercial grades of extracted honey to be recommended as standard for the United States by the Bureau of Agricultural Economics. The principles upon which the grader is founded have been patented by Doctor Pfund.

The cost of the grader is high, especially to the small beekeeper, and this fact is to be regretted, but it will nevertheless give the beekeeping industry a reliable and permanent instrument for grading the color of

honey. It will also serve as a standard for calibrating cheaper and more temporary graders.

PHYSIOLOGY OF BEES

The work started last year on the utilization of carbohydrates by honeybee larvæ has been completed. It was found that larvæ derived nourishment from the following carbohydrates listed in the order of their apparent value as food for the larvæ: Sucrose, levulose, melezitose, dextrose, trehalose, dextrin, galactose, and lactose. They received no nourishment from starch or glycogen.

A small but fairly satisfactory chemical laboratory has been equipped for making a study of the digestion and physiology of the honeybee. A research has been started to ascertain what becomes of nitrogen and fat in the body of the worker bee during the winter period of partial inactivity, and a number of preliminary analyses have been made. The mortality of adult bees during the winter months is large over the entire United States and amounts annually to at least 10 per cent of all bees. Although this loss can not be attributed to any one cause, the evidence is strong that the kind of winter stores is largely to blame.

DISEASES OF BEES

Experiments have been made with various materials having the requisite properties for disinfecting combs infected with *Bacillus larvæ*, the causative organism of American foulbrood, with special attention to a solution of formaldehyde and water. There is at present on the market a commercial disinfecting solution which is satisfactory for this purpose, but it is expensive and difficult for the beekeepers to procure, and it is hoped that, as a result of experiments, a cheaper and more efficient material will be found. Already a manuscript has been prepared dealing with the bacteriological phase of the effect of a water-formaldehyde solution upon the spores and vegetative forms of *Bacillus larvæ*. These tests indicate that this solution, bacteriologically, is as efficient as the commercial solution, but it lacks somewhat in penetrating power. Before an unconditional recommendation could safely be made for the use of this material it was deemed well to test the solution under actual apitary practice. Through the kindness of H. L. Kelly, a local beekeeper, this has been made possible, with the result that over 1,500 infected frames have been

treated. Preliminary data indicate that the solution will prove satisfactory.

There is now considerable discussion as to the part that commercial shipments of honey play in disseminating American foulbrood. This is a very important subject, especially in view of the fact that there is a movement on foot to attempt a country-wide eradication of this disease, which is continually threatening the beekeeping industry in many parts of the United States. Honey in commerce, as a carrier of bee diseases, is being investigated.

In the bee-disease routine work 781 samples have been diagnosed, with the following result: American foulbrood 296, European foulbrood 117, sacbrood 36, mixed infection 3, cultures of treated comb 42, adult bees 175, miscellaneous 112. Twenty of the samples of adult bees were examined for the presence of arsenic, and 11 of these were found to contain enough arsenic to account for the death of the bees; 58 showed the presence of *Nosema apis* spores, and 117 were negative.

Fifty-seven foreign queenbees and their attendant workers were imported into the United States from the following countries: Carniola, Transcaucasia, Austria, Rumania, Italy, Holland, Germany, Switzerland, and Algeria. All of these importations were free of the mite *Acarapis woodi*, the cause of Isle of Wight disease, which is common and widespread in Europe. The mite has not been found in this country in a four-year examination of samples from all parts of the United States. About half of the foreign importations contained spores of *Nosema apis*.

The work on the relation of fungi to the honeybee has been continued. Collections have been made of various forms of fungi, but the greater share of the time has been spent on species of *Aspergillus*. Two species with their related strains have been found to be virulent parasites of adult bees and of brood in all stages. One of these organisms, previously unknown in this country, which causes a disease known as stone brood in Europe, has been found on several occasions.

Beekeepers have been complaining for many years of the abnormal death of adult bees. Upon examination nothing could be found which would account for these conditions. The bees before death have varied so much in their reactions that a number of specific names have arisen, such as "May

disease," "June disease," "disappearing disease," "paralysis," and others. Several of the symptoms in bees supposedly suffering from some of the foregoing so-called mysterious diseases have been produced in the laboratory at will and it is hoped that the mystery surrounding some of the diseases of adult bees will eventually be cleared.

BEEKEEPING REGIONS IN THE UNITED STATES

Lack of funds has hampered work on this subject, although information on the best methods of beekeeping suitable to the various parts of the country has been accumulating. There is real need for more specific recommendations for beekeeping practice in several of the beekeeping regions where the potential possibilities for developing the industry are great. This is especially true throughout sections of the South and Southeast and in the irrigated sections of the West and Northwest. It is hoped that more active work in the field can be started next year.

DEMONSTRATIONS IN BEEKEEPING

Little active work has been done in the field on this project, as lack of funds prevents maintaining any representatives of this office in the field. Despite this handicap, the office has aimed to keep in as close contact with the beekeepers as possible, this having been done largely through correspondence. Members of the staff have attended 19 meetings held in 11 States. Four of these meetings were short courses. Many requests to assist in beekeepers' meetings and demonstrations in all parts of the country were received, but attendance at only a limited number was possible because of lack of funds, and no meeting was participated in west of the Mississippi River.

MISCELLANEOUS ACTIVITIES

The correspondence of the office has been heavier this year than at any previous time since the war, when the activities of the office were greatly augmented. This seems to indicate that the beekeepers of the country continue to be interested in the work of this office and have confidence in it.

INSECT PEST SURVEY

The work of the Insect Pest Survey has been carried on, as in the past,

under the direction of J. A. Hyslop. The survey has now functioned for four years and is recognized as an integral part of the cooperative work of the bureau and the entomological agencies existing in the several States and the Dominion of Canada.

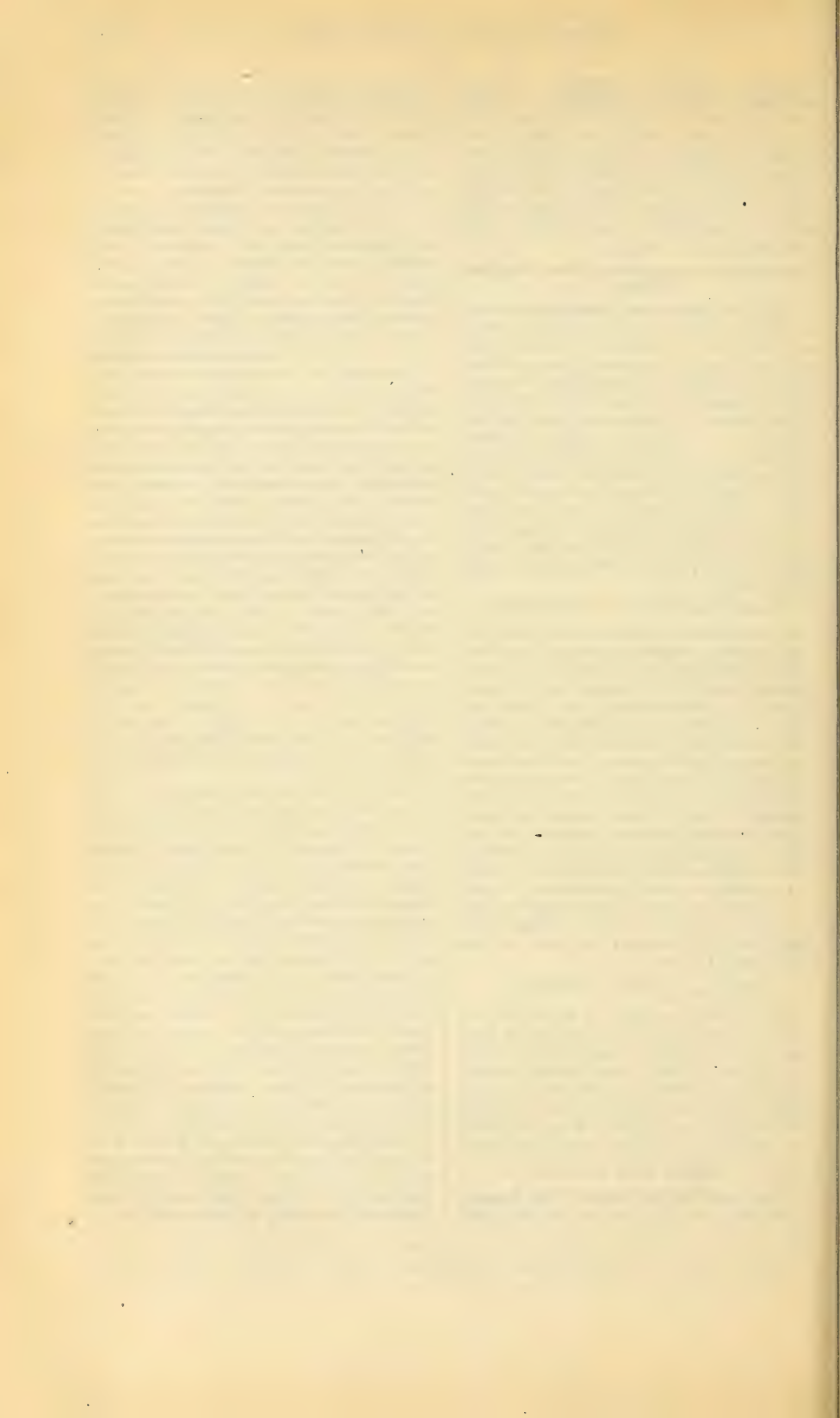
In 1924 the survey completed volume 4 of its monthly bulletins, consisting of 8 numbers and 327 pages of text material and an index of 36 pages. Nos. 1 to 4 of volume 5 were also issued during the last fiscal year, comprising 222 pages of text material. Urgent matter was handled in the form of special reports as heretofore.

The work on a common-name index, instigated by the survey and assumed by the American Association of Economic Entomologists, has resulted in the publication of a list of common names approved by the working entomologists throughout the country for general use. Subsequent appendixes are proposed as common names become necessary for additional species.

The technical paper on the correlation of climatic conditions with the abundance of the chinch bug throughout that part of the United States where this pest was a serious factor from the years 1870 to 1920, inclusive, is still in manuscript form and in all probability will be completed during the coming year. The delay in the completion of this paper was made necessary by the ever-increasing mass of material which the survey is handling.

The survey is now working on a project to incorporate in its files all the statistical data on economic insects of North America which have been published in the past. This of course will take many years, but when completed will make available the greatest mass of statistical information on insects extant. Work on an atlas of economic insects, started during the first years of the survey, has been temporarily suspended owing to lack of technical help. The survey's files now contain references to over 1,800 different species of insects reported as of more or less economic importance. These insects represent practically all of the major orders and fall into 1,194 genera.

The work of the survey has now reached a point where further expansion is impossible without technical assistance. Within the coming year this will probably be forthcoming.



REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., September 16, 1925.

SIR: I have the honor to submit herewith a report of the operations of the Bureau of Biological Survey for the fiscal year ended June 30, 1925.

Respectfully,

E. W. NELSON,
Chief of Bureau.

HON. W. M. JARDINE,
Secretary of Agriculture.

ORGANIZATION OF THE BIOLOGICAL SURVEY

The increasing occupation and development of the United States and its Territories makes it increasingly difficult to maintain even a fair representation of our once enormous natural resources in game and fur-bearing animals and game and insectivorous birds. At the same time the widespread herds of domestic stock and the extension of the farming areas have given predatory animals and harmful rodents of many species a stable and abundant food supply, under the influence of which their numbers increase and necessitate active control.

To accomplish the varied tasks involved in these problems calls for field and laboratory investigational work by trained specialists, and the maintenance of a warden service to safeguard Federal wild-life refuges and to enforce Federal game laws, as well as a force to conduct field campaigns to control animal and occasional bird pests. These activities also involve much educational and cooperative work. The work of the bureau is organized in seven divisions, as follows:

1. Economic investigations, A. K. Fisher, in charge. Necessary investigations are made and the organization and leadership furnished for cooperative campaigns throughout the country for the destruction or other control of predatory animals and injurious rodents.

2. Fur resources, Frank G. Ashbrook, in charge. Through experiments and investigations in fur farming and by close cooperation with associations of fur producers and the fur trade, studies are made of problems in the maintenance of the fur supply, both in the wild and under controlled conditions, and in the development of the fur industry.

3. Food habits research, W. L. McAtee, in charge. Studies are made of the food habits and economic relations of birds, reptiles, and amphibians; of the food resources of water areas suitable for migratory wild fowl; and of methods of increasing useful and controlling injurious birds.

4. Biological investigations, E. A. Goldman, in charge. Field and laboratory investigations are made of the wild life of the country, including technical studies to determine the classification of species, their life habits, and their migrations and distribution, for the purpose of mapping the natural life zones of this continent and of providing the fundamental scientific information necessary for the economic, regulatory, and other activities of the bureau.

5. Alaskan wild life, the chief of bureau and W. F. Bancroft, in charge. Problems concerned with the developing reindeer industry are studied, and assistance is given to native and other owners of herds; through representation on the Alaska Game Commission and in other ways fur production in the Territory is encouraged and ex-

pert advice and assistance given in matters affecting the future of Alaska's resources in game; investigations are conducted and assistance given to help develop stock grazing and fur farming on islands within the the Aleutian Islands Reservation.

6. Game and bird refuges, Smith Riley, in charge. Sixty-nine Federal large game and bird refuges are administered in the United States, Alaska, Porto Rico, and Hawaii through warden service and inspections; hay is produced on the elk refuge in Wyoming for winter feeding of the elk; and disposal is made by transfer for restocking purposes or by sale of surplus animals on the five big-game preserves under the bureau's jurisdiction.

7. Protection of migratory birds, George A. Lawyer, in charge. Federal laws are administered for the protection of migratory game and other birds, and laws governing interstate shipments and importations from foreign countries of wild birds and mammals.

Plans have been made for a temporary reorganization following the resignation of Smith Riley, in charge of reservations. He will be succeeded by E. A. Goldman, by transfer from chief of biological investigations, and H. H. T. Jackson will be placed in acting charge of the latter division. George A. Lawyer resigned as Chief U. S. Game Warden on September 15, 1925.

INJURIOUS WILD ANIMALS

A constantly increased food supply stimulates the increase of wild animals dependent upon it. The extension of farming and stock growing in their various branches over the entire United States has provided the needed food supply, and under its influence in various places in the West coyotes and wolves have rendered it impossible successfully to grow certain kinds of livestock upon which these animals prey. In other areas the multiplication of rodents with almost unbelievable rapidity about grainfields has increased the difficulty of successful production. Long experience has demonstrated that it is an economic necessity to combat such injurious wild animals in order that the losses to agriculture and stock growing may be reduced within tolerable limits.

Furthermore, the rapid and continuous spread of rabies from its outbreak in a single focus in California in 1909 through six of the Northwest-

ern States before it was controlled, with its appalling losses of livestock and a list of more than 2,000 persons bitten by rabid animals, of whom about 60 died, evidences the danger of permitting predatory animals to maintain themselves in great numbers in the midst of territory generally occupied by civilized people.

The losses of crops, livestock, game, and poultry from these animals have run into hundreds of millions of dollars a year. Campaigns against these pests, which are being led by experts of the Biological Survey, mainly west of the Mississippi River, have very greatly reduced their numbers and have vastly reduced the annual losses from this source.

Little objection can be raised to the continuance of a limited number of predatory animals in national parks and in wilderness areas remote from civilization, so long as they do not prove too destructive to the other wild life there. It must be taken into consideration, however, that with the growing numbers of hunters and the improved facilities for getting into the haunts of game, either the number of hunters seeking game or the number of predatory animals permitted to roam the forest must be reduced, or the resulting drain on game will mean its extermination.

Experience with wild animals in this country indicates that bobcats and coyotes will continue to exist in many areas within our territory in the distant future. Their numbers can be reduced in the districts where their destructiveness is most marked until losses are almost entirely eliminated, as has been well demonstrated within recent years. That these animals really will be exterminated in our territory before a very long time, is beyond reasonable probability. The case of the coyote is sufficient proof of this fact. Of recent years these animals, although constantly being destroyed as stock killers and for their pelts, still have not only continued to exist in practically all their former territory, but have vastly extended their range and now occur from Costa Rica, in Central America, to the mouth of the Mackenzie River, in Canada, and from wooded parts of Indiana to the Pacific coast. They possess the same extraordinary adaptability to environment which has enabled red foxes to persist so successfully in New England after several hundred years of pursuit by civilized man.

Less conspicuous but far more destructive in the aggregate than the predatory animals are the rodent pests

that not only reduce the forage available for livestock on the ranges but also are vastly destructive to agricultural products, as well as to roads, irrigation systems, levees, and railway embankments. To this list may be added the enormous losses of food and other products and property by the depredations of house rats. The control of each of these pests presents a special problem, requiring investigations of the habits, distribution, and economic relations of the animals. This work the Biological Survey is continuing both in the laboratory and the field. A field organization is maintained in most of the Western States to coordinate operations against these animal pests with the work of other Federal, State, and local agencies. Good progress is being made and each year the losses from this source are decreased.

Federal funds in the amount of \$429,642 were available for use during the year in destroying wild-animal pests on the public domain and for cooperative work elsewhere. Of this sum \$270,967 was used in the destruction of predatory animals and \$158,675 for the control of rodents. Organized work was conducted in 21 States, which provided cooperative funds totaling \$839,568 from State appropriations and other sources. Approximately \$389,374 of the cooperative funds were expended for the destruction of predatory animals and \$450,194 in rodent-control work.

PREDATORY ANIMALS

The conditions under which intensive work has been carried on for the control of predatory animals have shown marked improvement during the past 10 years. Originally organized to prevent wolves, coyotes, and other marauders from destroying livestock on national forests and other public domain, it soon became apparent that to assist the livestock industry adequately the work must be extended to cover State and private lands also. To this end, the aid of State and local agencies has been enlisted, and all efforts have been so successfully coordinated as to prove a gratifying demonstration of the possibilities of a correlation in which many organizations and many men can work together to reach a common objective.

Cooperating State agencies have included State departments of agriculture, livestock commissions or boards, game commissions, agricultural extension departments, county organi-

zations, and stockmen's and farmers' associations, as well as individuals. Predatory-animal work has been in progress in 16 States—Arizona, California, Colorado, Idaho, Michigan, Minnesota, Missouri, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. Arrangements also have been made whereby agencies controlling Federal lands, as the Forest Service and the Bureau of Animal Industry of the Department of Agriculture, and the Office of Indian Affairs and the National Park Service of the Department of the Interior, may participate and receive assistance in the work. The Bureau of Plant Industry and the Bureau of Chemistry of this department also have aided in consultations and laboratory investigations.

In order to cover economically the enormous areas infested by predatory animals the voluntary service of many farmers and stockmen has been utilized. These men were instructed how to treat their own ranges and prosecute the work on definite plans. A force of 402 trappers and poisoners has been employed under the bureau's supervision during the year and paid from Federal and State funds and from funds of other cooperating agencies. Skins having a market value and also the scalps of animals taken in trapping and hunting or found after poisoning operations were turned in by them as evidence, and include 352 wolves, 37,255 coyotes, 2,945 bobcats, 61 Canada lynxes, 228 mountain lions, and 201 bears. And it is estimated that about 80,000 additional coyotes were killed and their skins and scalps not taken, as it is not practicable to collect many carcasses after extended poisoning operations.

Wolves.—Gray or lobo wolves have gradually yielded to the intensive drive to clear them from the livestock-producing sections of the country and have now been reduced to such small numbers that there is only an occasional lone survivor or pair known to exist in the areas devoted to livestock production, aside from animals which cross into the United States from Canada or Mexico. Owing to their destructiveness of livestock and game, these animals can be tolerated only in unsettled country. Aside from purely economic reasons, their elimination in occupied country is essential to an intelligent conservation of the useful and attractive forms of wild life. This does not mean complete extermination of the species, for wolves will doubtless continue to exist indefi-

nately in the wilder parts of Canada and Mexico, where they now occur in large numbers.

Skilled hunters have been detailed to take destructive individuals wherever they appear and to patrol the borders, especially in Arizona and New Mexico, for those animals coming across the international boundary. Of the 31 wolves taken in New Mexico during the year, the greater part are believed to have come from Mexico, and of a like number killed in Arizona 21 had recently crossed the border. Despite unremitting effort only 31 wolves were taken in New Mexico, 31 in Arizona, 1 in Colorado, 1 in Utah, 1 in Wyoming, none in Idaho, 33 in Montana, and none in South Dakota, and this indicates the scarcity of these animals in their former strongholds. So far as known, scarcely a litter of young wolves was permitted to escape in these States during the year.

Reports during the current year indicate that the previous intensive efforts to take the outstandingly destructive wolves have been successful and have left relatively few, and these are wide-ranging animals which frequent the less-settled sections of the country. Ranges once heavily infested are now reported as showing no signs of wolves for more than a year, a condition prevailing for the first time in the memory of old-time stockmen of the West. As the wolves become fewer, it becomes increasingly difficult to locate them, for they travel long distances and change their range frequently. In spite of this, however, the hunters assigned particularly to wolf work have become so skillful that it usually takes only a few days to capture any wolf reported doing damage.

Coyotes.—Careful study of local conditions in consultation with stockmen and the execution of orderly plans for the systematic treatment of entire areas affected have made it possible to reduce the numbers of coyotes and to prevent much of the damage by them. Through the steady drive against these animals which has been in progress for approximately 10 years there is now probably not 1 coyote where before there were 10. Because the work has been stressed in livestock-producing sections, the losses over great areas of summer and winter ranges of sheep and about the lambing grounds have been practically ended. This in no wise implies that these cunning animals are becoming exterminated, for an ample breeding stock will continue to exist in many areas far in the future.

Mountain lions.—Careful study of the seasonal movements of mountain lions throughout their range has made control work possible. Although ordinarily hunted with dogs and rifles, they are also trapped and poisoned successfully, particularly through the use of oil of catnip as a bait. A few especially skillful men are employed regularly in hunting these animals and have dogs well trained for the purpose. Their work is supplemented by the employment for short intervals of local stockmen who are experienced, properly equipped, and thoroughly familiar with conditions in their own locality. The largest kill during the past year was made in Arizona, where 127 mountain lions were destroyed. Throughout the West 228 were taken, making 1,464 since this work was organized in 1915.

An unusual and unfortunate incident occurred in December, when a boy about 13 years old living near Malott, Okanogan County, Wash., was attacked and killed by a mountain lion within half a mile of his home, and the partially devoured remains were not found until several hours later. Tracks in the snow gave mute testimony of the events which had occurred during the pursuit till the lion leaped upon and killed his human prey. Due to the obliteration of the tracks and other signs by the large number of local hunters who took up the pursuit seeking the local bounty that was offered, the Federal-State hunters were unable to find the trail. A local rancher, however, while trapping for coyotes a month later about $4\frac{1}{2}$ miles from the scene, caught a 3-year-old cougar by one toe in a No. 3 trap. Examination of the stomach disclosed a bolus mainly of matted hair. This mass was carefully analyzed by one of the experts of the Biological Survey and identified as human hair similar to that of the boy, along with two pieces of blue denim cloth, one piece of white cloth similar to trouser pocket material, and a discharged .38-caliber cartridge shell which the boy had evidently carried in his pocket as a trinket.

Bobcats and lynxes.—Throughout most of the important livestock ranges the numbers of bobcats and lynxes have been materially reduced through hunting by private trappers for furs and by organized campaigns against them. During the year 2,945 bobcats and 61 Canada lynxes were taken by hunters operating under bureau supervision. Bobcats are readily caught by experienced hunters with trained dogs

and traps. Though more difficult to poison than many other predatory animals, considerable numbers are trapped with oil of catnip as bait. The general situation as regards these animals is quite satisfactory, for they can be promptly destroyed wherever individuals become addicted to killing livestock.

Bears.—Bears are considered game animals in a number of States, and as such receive protection. Hunters of the Biological Survey are strictly instructed to kill only such individuals as are known to be destructive to livestock or, in cooperation with State game departments, bears destructive to other game.

RABIES CONTROL

The measures employed to reduce the numbers of coyotes and bobcats, the principal wild-animal carriers of rabies, have served to reduce the possible incidence of this disease as compared with conditions existing about 1916 and 1917, when rabies was distributed over a vast area in the Western States by these and other carriers. Wherever outbreaks of rabies have occurred, either among wild animals or domestic dogs, the force of trained men employed by the Biological Survey and its cooperators has acted so promptly with local health officials and livestock sanitary boards in destroying the predatory animals in the district that the duration of the outbreak has been short and of minor intensity.

In Colorado the outbreaks noted in the previous annual report of the bureau were controlled, the spread of the disease was checked, and no new cases have been reported in recent months. Outbreaks of rabies were suppressed also on the Klamath Indian Reservation and in several places in eastern Washington. Sporadic recurrences of this disease are reported throughout the territory previously affected, but the present co-operative organizations have the situation so well in hand and are in a position to move so quickly that the disease is not again likely to escape from control and spread over an extensive area.

FOOT-AND-MOUTH DISEASE AMONG DEER

The series of outbreaks of foot-and-mouth disease in various parts of California in 1924 so vigorously handled by the Bureau of Animal Industry by fall were entirely suppressed among domestic livestock, but not before the

deer in the forests on the western slope of the Sierra Nevada Mountains in Stanislaus County had become infected. The range of deer is continuous up and down the entire length of the Sierra Nevadas, and across into the Coast Ranges of California and into Oregon and Nevada so that this infection presented possibilities of appalling consequences to the economic interests of California and the entire West.

In this emergency the assistance of the Biological Survey, with its trained force of hunters, was requested to isolate the deer and suppress the disease to prevent what might result in a national catastrophe. Under the direction of the field representatives of the bureau a force of more than 200 hunters and their camp assistants was established in a cordon encircling the infected area to prevent any possibility of diseased deer passing the line into other territory.

The work went on throughout the winter and 2,249 deer that had been infected with foot-and-mouth disease were killed. As the result, before the end of the fiscal year the hunters ceased to find evidences of recently infected deer, although the work was continued as a form of insurance. When the spring of 1925 opened and the deer returned to the high Sierras, guards were established in all the passes used by them in crossing the mountains toward the State of Nevada in order to prevent any possible passage of the infection to that State. Apparently this work was completely successful.

Certain persons, who learned of the considerable number of deer being killed, adversely criticized the operations. This, however, it is believed was through lack of appreciation of the danger.

In this work the Biological Survey cooperated with the Bureau of Animal Industry, the Forest Service, the National Park Service, the State department of agriculture, and the State game commission. In the spring of 1925 special efforts were required to prevent the spread of this disease among the deer in the Yosemite National Park.

INJURIOUS RODENTS

Rodent-control operations during the past 10 years show a most gratifying development in methods, in plans of field operation, and in the quantity and character of work accomplished, and the past year shows a steady progress. The direct benefits resulting from control operations against

the rodents which cause heavy losses in farm crops and forage grasses, and in truck and berry farms, orchards, vineyards, and nurseries, have resulted in a constantly increasing demand for this service. The first requests for assistance were in measures against the more conspicuously destructive rodents, but the demonstrated value of this control work, together with closer observation as to the destructive activities of rodents generally, has led to calls for assistance in operations against other less conspicuous but equally or even more destructive forms.

Particular attention has been given to correlating the efforts of the bureau with those of other Federal, State, and local agencies so as to avoid duplication in rodent-control operations and to concentrate upon the problem all available forces. Only in this way have the large-scale operations now in force been possible.

The bureau has had the hearty cooperation of the Office of Cooperative Extension Work and of the extension-service organizations of the agricultural colleges; and the work of county agricultural agents has been an important factor in bringing its service to the attention of landowners and accomplishing the local organization necessary to make its work fully effective. State departments of agriculture, county commissioners, and many agricultural, horticultural, and livestock organizations have participated, and where the work involved operations on Federal land, the Forest Service and the Bureau of Animal Industry of this department, and the Office of Indian Affairs and the Reclamation Service of the Department of the Interior, have cooperated to the fullest extent.

In cases where rodents serve as carriers of disease-producing organisms, arrangements are made to coordinate the work of the bureau with that of the United States Public Health Service of the Treasury Department and with State, county, and municipal health organizations. The field organization of the bureau has been built up with a view to carry results of its investigational work to the public in the most practical and economical way and to articulate this service with regularly established agencies within the States.

Prairie dogs and ground squirrels.—Improved conditions have been evident on the ranges from which prairie dogs and ground squirrels have been largely eradicated, and the harvesting of full instead of partial crops has added

materially to the returns from farming operations. Drought in many parts of the West emphasized the serious competition of these animals with livestock in the utilization of forage plants. In many areas it was necessary to remove livestock to pasturage elsewhere while the prairie dogs and ground squirrels continued to exist on the remaining vestiges of pasturage, preventing seed from being produced and even digging up the plants by the roots.

Such conditions convince stockmen of the desirability of clearing the ranges of these unwelcome competitors, so that the pasturage may be improved for the benefit of their herds. Rodent eradication is becoming recognized as one of the most direct and practical means of range improvement and a step that is absolutely essential if progress is to be made by the adoption of other range-improvement methods. Under the drought conditions existing on the open ranges, in some areas these rodents migrated in great numbers to cultivated fields and made serious inroads into the crops. As indicative of the concentration of these animals, 225 dead prairie dogs were picked up from 15 acres in a grainfield near Flagstaff, Ariz., following application of poison, but the number thus destroyed must have been far greater, since most of the poisoned prairie dogs die below the surface, where they can not be seen.

Desire to produce grasses, livestock, and farm crops instead of prairie dogs and ground squirrels has created a demand for assistance in the eradication of these pests throughout the West. Campaigns to destroy prairie dogs and ground squirrels resulted in the first treatment with poison baits of 11,552,667 acres of Federal and private lands, and follow-up work to eradicate most of the survivors on 7,704,863 acres. This, added to work accomplished since 1916 in Arizona, California, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, makes a total of 12,637,634 acres of Federal and 115,915,033 acres of State and private lands from which a large percentage of these pests have been destroyed.

In addition to paying the cost of poisoning operations on their own lands, farmers and stockmen have continued to contribute thousands of dollars' worth of labor in distributing poison on adjacent Federal lands. State officials and county commis-

sioners have aided by providing revolving funds to purchase poison supplies. The bureau continued to negotiate the purchase of poison materials in wholesale quantities for use on Federal lands and for cooperators, with a resultant saving in the cost of operation to the cooperators of many thousands of dollars. The saving in crops and range grasses from the work during the year is estimated at more than \$6,500,000. This does not take into account the permanent benefits which have resulted from clearing the rodents from other areas during previous years.

Seventeen counties are reported cleared of prairie dogs, and from 95 to 98 per cent of the prairie dogs and ground squirrels have been eliminated from many others. Practically complete protection of crops has been obtained where poisoning operations have been conducted systematically in accordance with the bureau's demonstrated methods. Introduction of new crops into the western farming areas is promptly followed by attacks by rodents. This makes necessary constant development and adaptation of methods to meet the advancements in western agriculture.

County agricultural agents have been active in stimulating interest in this work and in preparing quantities of the poisoned grain for local use. A total of 1,573 tons of poisoned grain have thus been prepared and distributed under the supervision of the bureau's representatives and cooperative State and county officials. Calcium cyanide has been successfully employed against the Columbian ground squirrel in Idaho, Washington, Oregon, and Montana, and is being used to supplement poisoning with strychnine-treated grains; 215,640 pounds of this fumigant have been used for the purpose. Carbon bisulphide has also been employed in a similar way, 664,522 pounds having been used during the year. Generally it costs more to apply fumigants than poisoned-grain baits, hence they are used chiefly in follow-up treatment to complete the eradication of the few prairie dogs or ground squirrels which remain after poisoning and also during seasons when grain baits are not effective.

Pocket gophers.—Demonstration by the bureau that the control of pocket gophers is feasible and that it can be accomplished at moderate cost has resulted in increasing operations against these pests in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota,

Oregon, South Dakota, Texas, Utah, and Washington. Interest in the control operations is developing rapidly as the extent of damage caused by these rodents in orchards, vineyards, alfalfa fields, and truck crops, and the serious injury which they do to levees, irrigation ditches, and railroad embankments becomes increasingly evident.

Water-users' associations and officials of the Reclamation Service are taking an active interest in the control of pocket gophers in irrigated sections because of the resultant savings in the cost of ditch-bank maintenance, and the protection afforded against damage to irrigated crops and orchards.

Many railroad lines are inaugurating pocket-gopher control work, both to protect their railway embankments and to aid the people of the communities they traverse by eliminating this source of infestation of the land adjacent to their right of way.

Demonstration farms on which pocket gophers are eradicated in co-operation with the owners have been established in a number of States, enabling the farmers in the vicinity to learn the methods employed and to see the benefits accruing.

Jack rabbits and cottontails.—Migration of jack rabbits from the open ranges into farming areas in search of food has been noted in many sections during the year. The invasion of rabbits in large numbers into cultivated fields threatened enormous damage to crops in Arizona, Colorado, Idaho, New Mexico, Oregon, South Dakota, Texas, Utah, and Washington. In some instances, where operations against them were not started in time, crops were destroyed.

Field representatives of the bureau demonstrated methods for destroying these animals in various localities, and great numbers of the rabbits were killed, thus saving many crops. In Roosevelt County, N. Mex., 20,000 rabbits were killed during an intensive two weeks' poisoning campaign, and it is estimated that not less than 150,000 were destroyed during the summer. In Washington, 77,900 were destroyed by poisoning and drives, in Utah 180,000, and in two counties of Oregon 200,000 in poisoning campaigns.

Owing to the extreme variability of jack rabbits in taking poisoned baits, it is often necessary in launching a campaign to conduct preliminary investigations to learn their food preferences. This was done in Morrow and Umatilla Counties, Oreg., where jack rabbits were coming in great

numbers from the open ranges to the cultivated crops. A poisoning campaign resulted in killing more than 200,000 of them which were counted, in addition to great numbers not found. As a result, the rabbits did only slight damage in most districts, as it was possible to kill them as fast as they moved in. In this campaign 1,445 ounces of strychnine were used, and some actual counts showed kills from 200 to 742 rabbits for each ounce of this poison.

Damage by cottontails to orchards, truck farms, and gardens was reported from many sections of the country. Since these animals are usually regarded as game they are ordinarily kept down to moderate numbers by hunters. Under these circumstances, the bureau has recommended protective devices which have afforded relief where damage was being done.

The fact that tularemia, a deadly epizootic disease among both jack rabbits and cottontails, may be communicated to man as a disabling and sometimes a fatal disease, is added reason for the control of these animals and for care in handling and dressing their carcasses. The bureau has kept in close consultation with the United States Public Health Service in reference to this aspect of the control problem. Valuable cooperative work was accomplished during the year in connection with an outbreak of tularemia in the vicinity of Carlsbad, N. Mex., in which thousands of jack rabbits succumbed to the disease and at least 17 persons were affected, one case terminating fatally.

An article entitled "The European Hare in North America," reviewing the history of its introduction, spread, present distribution and abundance, value as food, depredations, and control measures, was published during the year in the *Journal of Agricultural Research*.

Woodchucks. — Woodchuck control proved to be an important development during the year. Originally confined chiefly to rough, stony land, where they did relatively little damage, woodchucks have spread into cultivated areas and established themselves along levees, hedgerows, and other favorable retreats, and have invaded orchards and grain and root crops. By girdling orchard trees and feeding upon the products of the farm, woodchucks have become a pest of considerable importance. In the banks of levees their burrows frequently cause breaks in time of high water which are expensive to repair,

in addition to flooding adjacent farms and destroying crops, and in bridge abutments and along culverts they are responsible for serious washouts to roads.

The Biological Survey has conducted investigations and determined practicable methods of fumigating woodchuck burrows with carbon bisulphide or calcium cyanide. In Indiana, Illinois, New York, and Maryland 329 demonstrations were given and attended by 4,934 landowners. In 24 counties in Indiana, 92 demonstrations were attended by more than 2,000 farmers, and as a result 20,000 pounds of calcium cyanide were used. Similar interest in the other demonstrations was evidenced by a number of counties appropriating funds to purchase fumigating material in wholesale quantities.

In the Rocky Mountain and Pacific Coast States woodchucks are locally destructive, consuming considerable quantities of forage about mountain meadows and attacking orchards, alfalfa, and other farm, truck, and garden crops. The use of poisoning methods demonstrated by field representatives of the bureau has served to put a stop to much damage, and the work bids fair to grow rapidly and to result in the control of these rodents.

Mountain beavers are reported to be increasingly troublesome in sections of western Washington, and especially in areas where reforestation is being attempted and on berry farms and truck gardens. Methods of trapping and poisoning them have been demonstrated and assistance rendered in preventing damage.

Wood rats, are widely distributed throughout the West, and while they usually are of little economic importance, it has been found that they interfere seriously with reforestation. Attention has been directed toward stopping their destructiveness, especially to the redwood and Douglas-fir seedlings in the reforestation projects of several lumber companies along the Pacific coast. Damage by wood rats to seedling trees has run as high as 50 per cent on some of these areas, an important factor in the success or failure of reforestation projects, in some of which more than 3,000,000 seedlings are being produced. The cost of transplanting each acre of cut-over land exceeds \$12, and where damage from wood rats approaches 50 per cent the necessity for their elimination is obvious. Continued effort is being made to work out practical measures for their control.

Field mice.—Lessened damage by field mice during the year is largely due to the demonstrations given in many States where these rodents appeared in numbers and proved destructive in orchards and to various truck and garden crops. In Idaho there was a heavy migration of mice from the fields in the vicinity of the Boise River Valley, and while serious injury to fruit trees was threatened, a large part of it was prevented by the prompt use of poisoned grain, 3,960 pounds of which were distributed. Mice also developed threatening numbers in orchards of Washington and in other sections of the West, but prompt use of poisoned grain reduced their numbers so that little actual damage was done. Pocket mice appeared in destructive numbers in some of the grainfields, and 365 farmers treated 75,000 acres with 21,000 pounds of poisoned grain in infested places, resulting in complete protection to the fields. In the Eastern States investigations were continued upon pine mice, and assistance was rendered as requested in control measures to protect orchards, vegetable crops, and flower bulbs.

House rats and mice.—Because of the enormous damage to property and the serious menace to public health in the presence of rats and mice in the United States, the Biological Survey has continued investigations of methods for the control and elimination of these rodents and has aided in their control through furnishing publications, making demonstrations, and organizing local campaigns. Control has been made simpler as the public becomes aroused to the necessity of repressive measures and is adopting them more widely. The bureau has emphasized important measures of rat control, including rat-proof construction and repair of buildings, closing basement windows and other openings through which rats can gain entrance, disposing promptly of garbage and piles of refuse where rats find food or shelter, poisoning and systematic trapping, fumigating rat burrows with poisonous gases, using effective rat dogs, and organizing community drives to kill the animals and to stimulate popular demand for the permanent improvements which are required to eliminate them. Improved sanitary conditions have invariably followed these campaigns.

In cooperation with the Bureau of Animal Industry, work was done in California in destroying rats in build-

ings where foot-and-mouth disease had occurred. Demonstrations have been given and campaigns conducted in Arizona, California, Colorado, Idaho, Illinois, Indiana, Kansas, North Dakota, Oregon, South Dakota, Utah, Washington, Wisconsin, Wyoming, and the District of Columbia.

During the year investigations have been conducted to improve methods of combating rats, particularly about poultry houses, because of the destructiveness of rats to eggs and young chicks, and of their serving as possible carriers of avian tuberculosis. Although much of the rat-control work has been done in agricultural communities, the bureau has also cooperated with public-health and other municipal officials in the conduct of campaigns, of which the following is typical:

During the annual fire-prevention week in Denver, Colo., firemen visited all the schools of the city and, mentioning rats as one of the causes of destructive fires, requested support for the rat campaign to be held the following week. As a preliminary step, arrangements were made for the proper disposal of garbage, and publicity of the campaign was carried on through newspapers, the radio, posters, show windows, and advertisements. Many business houses ran a line in their regular advertisements calling attention to the rat campaign. Preceding the campaign, inspectors of the city health department met for instruction in mixing and placing poison and in the methods of baiting and setting traps. Each was made responsible for visiting every store in the section assigned to him to see that poison was put out or traps used according to the local needs and to give demonstrations in their use. Wholesale houses furnished supplies of meat and other bait materials. As a result thousands of rats were killed and, what is even more important, the people received instruction in the simple, practical procedure required for the control and elimination of these destructive pests.

Porcupines are becoming of increasing economic interest because of their destructiveness to forest trees and seedlings and their occasional raids upon corn, raspberries, and fruit trees, particularly cherries and prunes, and their feeding on and wallowing in alfalfa. Investigations are being conducted to determine improved methods of controlling the damage wherever these animals occur in destructive numbers.

MOLES

Investigations have been carried on to determine the simplest practical methods for the control of moles, complaints of damage by which continue to be received. The bureau has demonstrated and furnished information through correspondence and publications on methods for the control and elimination of these animals where they are doing damage in lawns, gardens, truck farms, pastures, and hay meadows.

EXHIBITS AT FAIRS

In cooperation with the Office of Exhibits the bureau has prepared material for use in the regular fair circuits and at stockmen's and sportsmen's shows, particularly in Arizona, California, Colorado, Montana, Oregon, Texas, Washington, and Wyoming. Damage by rodents and predatory animals has been graphically shown along with suitable control measures. Mounted specimens of some of the more important of these pests have been used, and field representatives of the bureau have added local interest by including live specimens of such animals as ground squirrels, prairie dogs, pocket gophers, wolves, and coyotes. Experienced leaders have been present to discuss these subjects with visitors and to furnish advice regarding field operations in progress for the control of injurious mammals. This educational work has proved valuable in stimulating cooperation in organized efforts for the control of wild-animal pests.

FUR RESOURCES

The study and conservation of fur-bearing animals has been for many years one of the projects of the Biological Survey, and activities in this line have included the rearing of fur animals in captivity, investigations of their diseases and parasites with methods for their control, the study of conditions on private fur farms, and the preparation of bulletins on the maintenance of the supply, both by legal protection in the wild and by production on fur farms. The growth of this work made it advantageous to organize a new unit in the bureau, the Division of Fur Resources, established on July 1, 1924, the objects of which are (1) to make more generally known the commercial importance of fur in industry; (2) to emphasize the need of maintaining the supply of raw material; (3) to explain methods by

which this supply may not only be maintained in quantity but improved in quality; and (4) to continue studies on an experimental fur farm in the production of fur animals under controlled conditions. The success of the bureau's educational work to develop a fuller realization of the fact that fur is a valuable natural resource which must be conserved if it is to be perpetuated is becoming increasingly evident.

FUR FARMING

Fur farming in the United States is steadily developing, and certain phases of the industry are coming to be a permanent addition to agricultural production. From questionnaires sent annually to fur farmers, lists of fur-animal breeders and their addresses in the United States and Alaska are compiled. Returns from these questionnaires indicate that there are approximately 2,000 farmers in the United States and Alaska engaged in the production of one or more species of fur-bearing animal, the majority of whom are raising silver and blue foxes. The total investment in the business is between \$15,000,000 and \$18,000,000.

Constant effort is being made to obtain information essential to the requirements of this growing industry. Fur farms in the United States and Canada have been visited for the purpose of learning improved methods in breeding, feeding, and handling fur animals and to study outbreaks of contagious disease and parasitic infestation, the latter to enable the bureau to advise ranchers how to combat similar outbreaks. A bulletin in press at the close of the year on blue-fox farming in Alaska will be of great use to those engaged in the industry as well as to those contemplating rearing blue foxes, either on islands or in fenced inclosures.

The bureau is also in touch with the progress of fur farming in foreign countries, particularly in Europe, where the industry has had a steady but quiet growth. During the past year several shipments of silver, cross, and red foxes, skunks, raccoons, and minks have been made from this country to Norway, Sweden, Scotland, England, France, and Switzerland. Fox ranches have been in operation for several years in Norway and Scotland and in the wilder parts of Northumberland and Yorkshire, England. The French Government was represented at the fox show held by the American National Fox Breeders Association at Minneapolis by a special

commissioner, who purchased several breeding foxes for use on the disabled war veterans' farm at La Havre, France.

Fur farms in Alaska.—Of the 10 islands in southeastern Alaska under the jurisdiction of the bureau available for the propagation of foxes 9 remain leased, and from reports of operations the lessees are meeting with fair success. Great interest is being manifested in blue-fox farming, and practically all suitable islands throughout the southern and southeastern parts of the Territory will probably be occupied for the purpose within the next year. During 1924 more than 200 fur farms, mainly for blue foxes, were being operated in southeastern Alaska.

The fact that 92 permits to capture land fur-bearing animals for propagation had been issued during the year is indicative of the increasing interest in this industry on the mainland and in southeastern Alaska. Of these permits 33 were for white foxes, the propagation of which is an extremely promising venture by residents of the Seward Peninsula and the coast of Norton Sound.

At the end of the year 75 permits had been issued for the production of foxes in the Aleutian Islands Reservation. The reports indicate that fur farmers are meeting with fair success, the conditions improving from year to year.

Experimental fur farm.—The experimental fur farm of the Biological Survey, at Saratoga Springs, N. Y., is now fully equipped for carrying on extensive experiments in feeding, breeding, and handling fur-bearing animals as well as for studying their diseases and parasites. Efforts will now be directed toward the building up of a breeding herd of foxes. The first purebred silver foxes owned by the Department of Agriculture were purchased during the year. There were 23 fox pups born at the experimental fur farm this year, all of which are doing well.

Experiments conducted at the farm have shown that the general principles of feeding, breeding, and sanitation as they affect the production of domestic animals can be applied to the production of fur-bearing animals. Breeding experiments in progress tend to prove that the characters of a "samson" fox (a fox which lacks the guard hairs and thus produces a nearly worthless pelt) are inherited and can be transmitted, rendering such animals valueless as breeders.

The wrong kinds of food and of methods of feeding as well as parasitic infestation are factors in producing inferior pelts, and further experiments are necessary to determine how they affect the quality of the fur.

Studies of the animals during the mating, gestation, and whelping periods are being continued, and improved methods of handling diseased animals during treatment have been devised and the data are being assembled for publication. Information regarding the tolerance of foxes to various drugs has been published in an article in the *Journal of Agricultural Research* (April, 1924) under the title "Anthelmintic Efficiency of Carbon Tetrachlorid in the Treatment of Foxes."

Various types of dens and pens have been constructed at the experimental farm to ascertain the kind best for the production of foxes in captivity. Drawings of those found most practicable have been prepared, and blue prints will be made available for free distribution.

During the year many visitors from all parts of the United States and Canada have inspected the farm, which is open to the public from 10 a. m. to 4 p. m. on Wednesdays and Sundays from June 1 to December 1.

COOPERATIVE WORK

In dealing with the protection of fur animals in the wild the policy of the department is one of cooperation and coordination and not control. The maintenance of the fur supply in the wild must be brought about mainly through the protection afforded by State laws, but the Biological Survey by investigations and educational work in cooperation with the State officials and others concerned desires to assist actively in building up the fur resources.

The legislatures of 41 States were in session this year and more than a dozen considered measures affecting their fur animals. It was possible for the Biological Survey, in response to requests, to assist several State game commissions and other officials and conservation societies in drafting proposed new laws and revising old ones for the protection and propagation of fur bearers.

Other cooperative work included the attendance of representatives of the bureau at meetings of conservationists, fur traders, and fur farmers, where, upon request, information and suggestions were given and cooperation enlisted in matters affecting the

protection of the source of supply of the raw materials of the fur industry.

The bureau has kept in close touch with the National Association of the Fur Industry, the American National Fox Breeders Association, and the Canadian Silver Fox Breeders Association, and when requested has sent representatives to their meetings. Encouragement has been given to State fox breeders' associations to affiliate with the American National Fox Breeders Association in order to build up a stronger and more efficient supporting organization. The American and the Canadian silver-fox breeders' associations have been encouraged to enter into a reciprocal arrangement with regard to the registration of purebred silver foxes.

The annual fur-law bulletin was published during the year as Farmers' Bulletin No. 1445.

STATISTICS OF FUR

Basic statistical data regarding the annual catch of fur animals and the trend of the fur trade have been assembled during the year under a co-operative agreement between the bureau and the National Association of the Fur Industry, the results to be published by the latter in its Yearbook for 1925. The preliminary work was nearly completed at the end of the fiscal year, but the study will be continued with a view to departmental publication from time to time of the information gathered and the deductions made. In this undertaking, which is essential to a grasp of the conditions underlying fur trapping and the fur industry, the bureau desires the cooperation of all agencies interested in the fur resources, of other countries as well as this.

FOOD HABITS RESEARCH

ECONOMIC STATUS OF FISH-EATING BIRDS

Pelicans.—As a part of the intensive study of fish-eating birds, which for some years has been carried on by the Biological Survey, an important field project was conducted at Pyramid Lake, Nev., during the past fiscal year. Since time immemorial a large colony of white pelicans has nested on Anaho Island in that lake. The colony now numbers about 10,000 adults, which, by reason of interference by man, natural enemies, and the elements, rear less than 1,000 young a season.

Complaints had been made that the pelicans at Pyramid Lake were seri-

ous enemies of trout, the most prized fish of the region. These charges were disproved, however, since only two trout were found in the food of the pelican colony during the entire course of a three-months' investigation, and indications were that they had not been caught alive, but had been picked from a number of dead fishes observed at the time in stagnant pools along the lower Truckee River. The fishes most often caught are the abundant species that swim near the surface of the water, the usually deep-lying trout being beyond reach of the white pelicans, as these birds rarely dive.

The findings in this investigation are similar to those resulting from studies of pelicans in other regions. The birds seem to subsist almost exclusively upon coarse and common fishes not used as food by man, and instead of doing the vast damage their size and fishing expertness suggest, they are practically harmless, even in those few places where they do exist in numbers. At Pyramid Lake, lake minnows, carp, and lake chubs are the staple foods of the pelicans, with red suckers, Sacramento perch, and catfish distant seconds in point of quantity consumed. The loud complaints against the white pelicans of Pyramid Lake, as in the case of the brown pelicans in Florida, are generally based on the fact that overfishing with nets or other means has greatly reduced the fish supply, and the blame is placed on these birds rather than where it belongs.

Night herons.—Another important study of fish-eating birds was conducted on the Mashpee River, Mass., where night herons, probably stragglers from a large colony at Barnstable, were charged with being destructive to trout. Examination of the stomach contents of 35 of the birds showed no evidence in support of the charge, a result agreeing with careful study made by other investigators of the food of these birds in the extensive rookery at Barnstable. There is no evidence that night herons in Massachusetts ever catch trout except where large numbers of the fishes are confined in small ponds, as at fish hatcheries, and there is already in effect under the Federal migratory-bird treaty act authorization for owners or superintendents or their employees to destroy the birds at fish hatcheries.

Mergansers and great blue herons.—An investigation of mergansers, or sheldrakes, and great blue herons in Maine showed that both species were

feeding on trout, and recommendations were made that full-salaried employees of the State game department be permitted to shoot birds of these species, but that the great blue herons should not be killed or disturbed in or near their nesting colonies.

Cormorants.—At the close of the fiscal year a study was in progress of cormorant colonies in Minnesota and North Dakota, which are bitterly complained of by commercial fishermen.

Examinations of the stomachs of fish-eating birds received at the Washington laboratory were brought to date.

STATUS OF OTHER BIRDS

Blackbirds.—A comprehensive investigation of the relations of blackbirds to the rice industry is at last made possible through the cooperation of rice growers in the Crowley, La., region. It is planned to make this study exhaustive, in order to demonstrate the exact status of blackbirds in relation to rice and if possible to devise practicable methods of control where needed.

Herring gulls.—A study of herring gulls in Maine revealed that their reported depredations on young lambs are of very rare occurrence, and that the devouring of fish scrap spread for fertilizer is no longer of importance, since little fertilizing is now done there by this method, but that in certain years the birds do consume noteworthy quantities of blueberries. This sporadic destructiveness was not deemed important enough, however, to call for control measures at this time.

FOOD RESOURCES OF WILD FOWL

Surveys of the lakes and marshes of Minnesota were continued and good progress made. At the request of the Pennsylvania board of game commissioners Presque Isle was inspected and a report rendered on its value as a feeding ground for wild fowl and upland game birds, together with recommendations for improvement.

Back Bay, Va., where a shortage of wild-duck foods has been a matter of concern to numerous sportsmen, was surveyed and the dearth of duck-food plants was determined to be due to an increase in the salinity of the water. The State of Virginia, in cooperation with sportsmen interested in the area, has constructed a barrier which is expected to keep out storm tides from the ocean, the principal source of the salt.

Local inspections of wild-duck food conditions were made also in two localities in Maryland and suggestions made for improvement.

EXAMINATION OF STOMACHS OF BIRDS

The contents of 2,628 bird stomachs and of 256 owl pellets were analyzed during the year. Nearly two-thirds of the stomachs were of English sparrows, advancing the study of the stomachs of this species on hand and making a total of nearly 10,000 stomachs of this species examined. This study, to ascertain the present-day status of the English sparrow, has been in progress for some years, and the number of stomachs examined, far larger than has ever previously been used to determine the economic status of any bird, should be sufficient to yield definite and conclusive results.

Among examinations of special lots of bird stomachs for correspondents of the bureau may be mentioned buff-breasted sandpipers from Manitoba, wild ducks from Louisiana for the State conservation commission, and ruffed grouse from New York for the State college of forestry.

PROPAGATION OF GAME BIRDS

Supplementary to inspections made in the latter part of the previous fiscal year, visits were made to additional game farms in New York, New Jersey, Pennsylvania, and Virginia for the purpose of studying methods of propagating game birds. The information gained on these trips, together with data compiled from various published sources, has been incorporated in a manuscript for publication on the propagation of game birds.

COOPERATIVE QUAIL INVESTIGATION

The cooperative quail investigation being carried on by the Biological Survey and a committee of sportsmen in southern Georgia and northern Florida is now well along in its second year, and interesting and valuable results continue to be obtained. Eighty-five quail nests were studied during the year, the majority by visiting them as frequently as circumstances allowed, and a few from observation blinds. Many detailed data were gathered on the bobwhite's habits and behavior during the nesting season.

It was found that 60 to 75 per cent of all nests in which eggs are known to have been deposited were destroyed by the numerous enemies of bobwhite. Many of the landowners have started

a campaign against the mammals found to be responsible for the greatest damage. A trap has been developed and thoroughly tried out at the field headquarters of the investigation and built in sufficient quantity to be used with great success on many of the plantations.

A total of 1,139 native quail were netted or trapped and banded during the year, the exact locations being marked on large-scale maps of the areas where the work was carried on. Of the Mexican quail released on one of the large preserves, 323 were carefully banded also and will be traced through this method. Other birds, to the number of 1,021, principally small seed-eating species wintering or resident in the region, were incidentally caught and banded. A few important returns from the banded quail have been reported, but no great numbers are expected until the next and following shooting seasons. Valuable and interesting information, however, has already been obtained by retrapping banded birds.

Six hundred and sixty-two crops and gizzards of quail have been collected and temporarily preserved, by far the larger number from birds shot by sportsmen during the winter months, and all preparations completed for analyses of their contents, which has been barely begun. Many quail were carefully examined during the hunting season and a series of weights and other statistics gathered.

As a basis for the food study, effort has been made to complete as far as possible the reference collection of seeds and seed-bearing plants of the region, and of insects likely to be eaten by quail.

Complete propagation equipment, patterned after that in use on the Virginia State game farm, where thousands of young quail are being raised, was built to accommodate 10 pairs of breeding quail and their expected progeny, and experimental propagation is being carried on at the headquarters of the investigation. Experiments are being carried on also with skunks, opossums, raccoons, weasels, and other mammals, and of reptiles suspected of destroying the nests and eggs of quail, and 10 pens for their accommodation have been built, as well as a large pen in which the actual experimenting is conducted.

A pamphlet detailing the progress of the investigation during its first half year was published by the cooperating committee under the title

"Progress on Cooperative Quail Investigation, 1924."

MISCELLANEOUS INVESTIGATIONS

Plans to investigate the reported destruction of birds by insect-poisoning operations in cotton fields were rendered largely futile by drought, which itself kept down the numbers of boll weevils and made poisoning unnecessary.

The increasing use of cyanide dust against pests, together with reports of its successful use against objectionable roosts of birds, suggested its trial where birds are roosting about buildings. In experiments on starlings and pigeons it was found that great execution can be effected where the roosting site is protected from air currents and more or less overhung by structures that will partially confine the gas.

Brief field investigations not previously mentioned included inquiry into reported damage to newly sown grain and to small fruits by band-tailed pigeons in Washington, Oregon, and California, and alleged destruction of trout by mergansers in California. The results of field investigations of these complaints usually failed to substantiate the charges.

Manuscripts submitted for publication during the year in addition to that on the propagation of game birds, previously mentioned, were an extensive treatise on the local control of birds with special reference to crop protection and a brief one on natural land values for incorporation in a general report on the pine-woods section of the southern United States.

A department bulletin on "Food Habits of Some Winter Bird Visitors" was published during the year, and there were in press at the close of the year bulletins on "Food of the American Phalaropes, Avocets, and Stilts," "Food Habits of the Vireos, a Family of Insectivorous Birds"; and "Homes for Birds."

FOOD OF MAMMALS AND AMPHIBIANS

Stomachs of mammals examined during the year included those of deer from the Kaibab National Forest, where large numbers of these animals were threatened with starvation; of various small mammals, mostly skunks, for the Museum of Vertebrate Zoology, Berkeley, Calif.; and of a mountain lion from the State of Washington, which contained human remains and constitutes one of the very few

authentications of attacks of this animal upon man.

Stomachs of 340 toads, frogs, and salamanders were examined during the year. In all, the contents of the stomachs of about 2,000 toads have been analyzed, representing 29 species and all forms found in North America north of Panama. Fourteen species of the more uncommon West Indian toads were not available, but all the others were studied, and every species occurring within the United States was represented by an adequate series. The food taken by toads is so varied that it required nearly 10,000 index cards to record the information obtained. The preparation of itemized lists of stomach contents of the various species is now in progress and the tabulation of percentages of types of food has been completed.

BIOLOGICAL INVESTIGATIONS

Field investigations and technical laboratory studies of North American birds and mammals have occupied much of the time of the scientific force of this division throughout the year. Assistance in solving problems of identification, distribution, migration, and life histories of birds and mammals has been given on request to scientific and educational institutions, public and private museums, and individuals throughout the country, and to some extent in foreign countries. More than 1,500,000 cards bearing data on these subjects and pertaining to a majority of the approximately 3,500 forms of birds and 2,500 of mammals known to inhabit North America north of Panama are now in the files of the bureau. These files, which are daily drawn upon to answer correspondence on a multiplicity of subjects, and are indispensable in the administration of the work of the bureau, represent the accumulation of many years, and, gathered as they are from a great variety of sources, they form an unequaled repository of information.

TECHNICAL STUDIES OF MAMMALS

Continued substantial progress was made on a monograph on the ground squirrels of the genus *Citellus* and their relatives, a group of animals of great economic importance because of the millions of dollars damage they do to crops and forage, and of the fact that certain species are carriers of pneumonic and bubonic plagues and spotted fever. The desirability of learning as much as possible of

the distribution and habits of species of such enormous destructive potentialities is obvious.

A revision of another interesting group, the long-tailed shrews (*Sorex* and related genera), is virtually completed. These little animals, almost entirely insectivorous, are doubtless of some economic importance, although their food habits are not sufficiently known to justify the formulation of definite conclusions. Studies of the kangaroo rats of the genera *Dipodomys* and *Microdipodops*, a group of marked economic importance, are also progressing. A revision of the pikas (*Ochotona*) (North American Fauna No. 47) was published during the year, and a technical study of a typically western species of meadow mouse (*Microtus montanus yosemite*) also appeared (Journal of Agricultural Research, June, 1924).

BIOLOGICAL SURVEYS OF STATES

No important field work in surveys of States was possible except in Florida, special attention being given in the spring of 1925 to the breeding ranges of important species in the northern and central parts of the State. Data have been obtained for the preparation of an extensively annotated report on the birds of the State, and tentative plans have been made with a State institution for its publication. In several other States work primarily concerned with other lines of investigation has added important data to those previously accumulated, thus augmenting the value of the ultimate reports.

Completed manuscripts on the mammals of North Dakota and of New Mexico and on the birds of Texas and of New Mexico are still unpublished. In the case of the last named there is prospect of its publication in cooperation with State organizations, and the manuscript is now being brought up to date. Other reports well advanced include fully annotated lists of the mammals of Oregon, the birds of North Dakota, and the birds and the mammals of the State of Washington.

NATURAL HISTORY SURVEY OF ALASKA PENINSULA AND UNIMAK ISLAND

In the spring and summer of 1925 a cooperative expedition made a survey of the wild life in the western part of Alaska Peninsula and Unimak Island, the easternmost of the Aleutian Chain lying within the great Aleutian Reservation. This region lies within the northern breeding grounds of various

species of migratory wild fowl and is inhabited by many caribou and large brown bears. The rapid decrease of caribou there within recent years and the visits of many hunting parties in pursuit of brown bears made desirable a study of conditions by a competent naturalist to afford a basis for any proposed action for the further protection of the wild life in one of the least known parts of Alaska.

DISTRIBUTION AND MIGRATION OF BIRDS

Data on the movements of birds have been received from about 175 volunteer observers throughout this country and in many parts of Canada, many of whom have sent in similar reports for a number of years. A report on the distribution and migration of the swallows, a group of great economic importance, is in preparation.

During the year a circular was published on "The Spread of the European Starling in North America" (Department Circular 336). This bird is becoming familiar in the Eastern and Northeastern States, although it was established in this country only as recently as 1890. It is of local occurrence as far west as central Ohio and south to Georgia and Alabama, but many years may elapse before the bird becomes sufficiently numerous to be of economic importance west of the Alleghenies.

BIRD CENSUSES

Bird censuses, actual enumerations of pairs of birds breeding on certain representative areas, usually occupied farm lands, were received from about 70 observers, scattered over a large part of the country. The most valuable were taken on areas reported on during previous seasons, usually by the same persons. A sufficient number of such observations will make possible a useful estimate of the total bird population of the country, and to this end efforts are being made to increase the number of these volunteer enumerators.

BIRD BANDING

Notable progress has been shown during the fifth year of the bird-banding operations as carried on by the Biological Survey. As a means of gathering data on the seasonal and local movements of birds, experience with the banding method has fully justified expectations. The number of volunteer cooperators has increased to about 1,100, despite the fact that

the conditions governing their selection have been made more rigid. The number of Canadian cooperators is 97. The total number of birds banded during the year was 64,253, and the number of returns recorded was 3,187, as against 40,432 and approximately 2,000, respectively, last year.

The regional cooperative associations established to promote interest among the members have shown marked activity. The Northeastern and the Eastern Bird Banding Associations have begun to issue bulletins which promise to become increasingly useful. The Inland and the Northeastern Associations have made special efforts to band gulls, terns, and night herons, resulting in the accumulation of important information. The Western Bird Banding Association was formed by a reorganization of the banding chapter of the Cooper Ornithological Club.

A report entitled "Returns from Banded Birds, 1920 to 1923" (Department Bulletin No. 1268), which appeared early in the year, gives the details of the recovery during four years of 1,746 birds of 98 species. The data obtained by banding, especially those relating to ducks and other game species, furnish important information in connection with the administration of the migratory-bird treaty act.

The cooperative expedition sent to the Yukon Delta region in the summer of 1924 afforded opportunity not only to band numbers of game birds which breed in that section and winter in the Western States and farther south, but also to obtain valuable data on distribution and breeding habits. The banding work was especially successful in the case of the cackling goose, a bird which breeds mainly in this section, and which was captured in considerable numbers by the aid of a party of resident Eskimos. From these banded birds an exceptionally large percentage of returns was obtained in a rather limited area in California, suggesting the desirability of guarding carefully such species as breed and winter in comparatively restricted areas.

GAME IN NATIONAL PARKS AND FORESTS

During the latter half of August a representative of the bureau accompanied a committee appointed by the Secretary of Agriculture to make an investigation of the conditions affecting mule deer on the Grand Canyon National Game Preserve in

Arizona. The deer were found to be in a very serious condition because of overgrazing of the range, combined with a continued increase in the numbers of the animals. Recommendations were made for the reduction of the herds to avoid further losses. These studies were followed in June, 1925, by another investigation, in cooperation with the Forest Service and the National Park Service, of the critical game problem that has developed. This work remained unfinished at the close of the fiscal year.

Late in October and early in November, in cooperation with the Forest Service and the National Park Service, an assistant made a thorough study of the elk situation in the Gallatin Valley in northeastern Yellowstone Park and the adjacent parts of Montana, with special reference to winter conditions. It was found that the Gallatin Valley could well support a larger elk population than now winter there, and measures to increase these numbers were recommended.

INTRODUCTION OF TROPICAL GAME BIRDS

Attempts were continued to capture and transport from Guatemala living examples of ocellated turkeys, curassows, and tinamous to Sapelo Island, Ga., the expense being borne by Howard E. Coffin, who is cooperating with the bureau in the work. The turkeys obtained during the summer of 1924 all died, but it was determined to spend another season in a final effort. Reports from the field state that at the end of June more than a dozen living ocellated turkeys were on hand and that about the same number of eggs were being incubated. During the last two breeding seasons chachalacas from northeastern Mexico have bred freely in the forests of Sapelo Island, where they appear thoroughly at home.

STUDIES OF INJURIOUS RODENTS

Fenced quadrats established in Arizona several years ago for studying the relation of rodents to agriculture, horticulture, and forestry have been kept under observation. The results of investigations of damage to range grasses by the Zuni prairie dog, based on this work, were published during the year as Department Bulletin No. 1227.

Investigations also were made of the relation of the porcupine and other rodents to reforestation in the Southwest, the relation of jack rabbits to

agriculture and stock raising, and the habits of certain species of injurious rodents peculiar to the northwest coast region. The porcupine is one of the rodents now known to increase periodically to excessive numbers in certain regions, after which through an epizootic disease it may be reduced nearly to point of extermination. Porcupines in many western forests have recently become so abundant that they are destroying timber on a very large scale by girdling, and their effective control is a serious problem pressing for solution.

Studies in cooperation with the Pennsylvania Game Commission demonstrated the feasibility of capturing and moving beavers to locations where they are not objectionable.

At the instance of the Louisiana Conservation Commission a cooperative study of the status of the muskrat has been begun in that State, and interesting results are expected. Marshland areas in the southern part of Louisiana produce immense numbers of these valuable fur bearers, greater monetary returns from which might be realized if more were known of the factors governing their abundance. The bureau therefore selected a naturalist who will spend at least a year studying the life habits of the muskrat and other resources of the marshes in order to learn as much as possible of their interrelationships. This work will be supervised from time to time by representatives of the bureau.

ALASKA GAME AND LAND FUR ANIMALS

THE ALASKA GAME COMMISSION

A most notable conservation measure passed by the last session of the Sixty-eighth Congress and signed by the President on January 13, 1925, was the Alaska game law. The bill was formulated with the benefit of suggestions and advice from many sportsmen and conservationists, not only among residents of Alaska but also in the United States, who were directly interested in the maintenance of the wild life in that great area. The law is one of the most complete and effective of its kind ever enacted, and through it the game and fur resources of the Territory should not only be maintained but increased. Vast areas in Alaska are of such a character that wilderness conditions with game and fur-bearing animals will undoubtedly persist there indefinitely.

One of the most important provisions of the law was the establishment of an Alaska Game Commission of five members to be appointed by the Secretary of Agriculture, one from each of the four judicial divisions of the Territory, the fifth member under the terms of the law to be the chief representative of the Biological Survey resident in Alaska, who becomes its executive officer and fiscal agent.

The members of the commission have shown the greatest interest in the responsibilities placed in their hands, and the outcome of their first meeting, held in April, 1925, was the recommendation for adoption by the Secretary of Agriculture of a most comprehensive set of regulations governing the taking of Alaska game and fur bearers. These have been published as a Service and Regulatory Announcement (No. 1) of the Alaska Game Commission. Under the guardianship of resident commissioners appointed by the Secretary of Agriculture, who will have available for their use the vast store of information on birds and mammals in the files of the department and the close cooperation of the Biological Survey, there is a much brighter outlook for the future of Alaskan wild life.

LARGE GAME ANIMALS

Game on Unimak Island.—It is planned to hold Unimak Island, the easternmost of the Aleutian Islands Reservation, as a big-game refuge, where caribou and big brown bears may remain long after they have disappeared from many other parts of their range. This island, which is about 75 miles long and 25 miles wide and is made up of moderate slopes and broken mountain country, still maintains a considerable number of Grant caribou and brown bears. The wild life of the Alaska Peninsula may be affected adversely by the development of oil wells and other industries, and the policy of continued protection on Unimak Island should insure the perpetuation of some of the big-game animals of that region on part of their original range.

Stocking game areas.—The Alaska Legislature at its recent session appropriated \$10,000 to be used by the Alaska Game Commission in stocking islands and other areas with game and fur bearers not already existing there. A general survey has been made of the opportunities, and by the stocking of many islands now lacking in various valuable species

thus made possible, a considerable increase can be brought about in the game and fur production of the Territory.

Starving deer saved.—During the winter of 1925 an extraordinarily heavy snowfall on the islands of southeastern Alaska forced great numbers of Sitka deer down to the beaches, where, in serious danger of starvation, they were feeding only on the seaweed exposed at low tide. This serious situation was called to the attention of the bureau by radiograms from its employees and from the heads of chambers of commerce of Juneau and other towns, one telegram stating that 160 carcasses of deer had been found in a single locality.

Unfortunately the department had no funds which could be legally used for saving the deer, but at once brought the situation to the attention of conservationists, and a prompt response came with contributions obtained by the president of the National Association of Audubon Societies from friends, including members of the conservation committee of the Camp Fire Club of America; the president of the American Game Protective Association added \$250 and the president of the American Humane Association of Albany \$500, making a total of \$2,319. This was promptly made available to the representative of the Biological Survey at Juneau.

A supply of baled alfalfa hay was purchased, and with the cooperation of the people of that region, including representatives of the Forest Service and the Bureau of Fisheries, trees were cut for forage, hay was distributed along beaches frequented by the deer, and other measures taken for the benefit of the starving animals, with the result that instead of the loss of whole herds, a very large number were saved to perpetuate in the region a valuable game species.

LAND FUR ANIMALS

Shipments of fur.—Despite the trapping of large numbers of fur animals every year, reports by postmasters and agents of transportation companies of shipments of furs from Alaska from December 1, 1923, to December 31, 1924, indicate that the land fur bearers continue to hold their own, except muskrats, which show a decrease of 25,558 from the figures for the year ended November 30, 1923. This decrease, together with the close season on beavers and martens, resulted in a slight decrease in the total number

and value of pelts shipped. The number exported in 1924 was 285,545, valued at \$1,657,448, as against 396,369, valued at \$1,702,000, in 1923. Skins brought out of the Territory as personal baggage by travelers and by vessels not reporting them, and skins of blue and white foxes from the

Pribilof Islands, which are under the jurisdiction of the Bureau of Fisheries, and furs used in the Territory will no doubt bring the value of land furs taken in 1924 fully up to \$2,000,000, if not more.

The number and value of the principal pelts are as follows:

Number and value of the principal pelts shipped from Alaska during the period December 1, 1923, to December 31, 1924

Kind of fur	Number	Value	Kind of fur	Number	Value
Mink.....	39,356	\$334,526	Beaver.....	5,713	\$114,260
Red fox.....	13,353	267,060	Lynx.....	3,323	73,106
White fox.....	5,728	229,120	Silver-gray fox.....	372	46,500
Muskrat.....	194,053	194,053	Cross fox.....	1,284	44,940
Marten.....	6,019	150,475	Otter (land).....	1,950	43,875
Blue fox.....	1,640	131,200	Weasel (ermine).....	10,724	16,086

Seizures and prosecutions.—Forty-three cases involving violations of the game and fur laws and regulations in Alaska were reported during the year, of which 5 were violations of the migratory-bird treaty act and regulations, 18 of the Alaska game law and regulations, and 20 of the fur law and regulations. Of these 43 cases 3 were dismissed, 3 are still pending, and in only 1 case did the grand jury fail to indict. Nineteen seizures and confiscations were made, consisting of 335 beaver skins, 6 red-fox skins, 3 guns, and 1 trap. Fines amounting to \$716.50 were imposed, ranging from \$10 to \$200, not including costs, and three violators were given jail sentences.

Patrol work by boats.—The bureau's sea-going power boat *Sea Otter* was on extended patrol work in the administration of game and fur laws in southeastern Alaska during the year, being away from its headquarters at Juneau 207 days and traveling 7,848 nautical miles. Fur farms were visited and the fox farmers assisted and given all information possible. At the close of the preceding fiscal year a small power boat, the *Marten*, 30 feet in length, was purchased for patrol work in the enforcement of game and fur laws in the waters of southern Alaska, principally Cook Inlet. This boat traveled 2,281 miles during 97 days' absence from its base of operations at Anchorage.

REINDEER INVESTIGATIONS

Investigations among the reindeer herds continued throughout the year, covering the occupied ranges from the Yukon Valley northward along the coasts of Bering Sea and the Arctic

Ocean. The assistant chief of the bureau spent most of the summer of 1924 visiting reindeer ranges as far as Kotzebue Sound to learn the conditions with which the bureau must deal. The bureau representatives assisted in round-ups of herds and conferred with native and white owners as to range management and as to means for finding a more ready market for the surplus animals. The increase in the herds has far outgrown local demands for reindeer meat, and it is becoming urgently necessary that some way be found to dispose of the surplus animals in the herds of the Eskimos as well as of the white owners by establishing cold-storage plants at proper intervals and erecting corrals with suitably constructed chutes. The natives are showing a good spirit of cooperation with the bureau's agents in working out their problems.

From surveys made during the year it is estimated that there are about 350,000 reindeer in Alaska in 110 herds. Numerous reindeer herds were visited and suggestions made for improving methods of handling the animals on the range and for the proper reduction in number and selection of bulls, and improved methods of branding and of castration.

Observations of range-study quadrats and of the abundance and distribution of forage plants continued. Many of the reindeer herds which bureau agents had visited before show marked improvement as a result of suggestions for better care and handling. Little effort has been found necessary to induce native herd owners, when once convinced, to cooperate in adopting improved methods in herd management.

The transfer of the Reindeer Experiment Station from Nome to Fairbanks will be completed early in August, and another assistant has been added to the reindeer force. Plans are being worked out to conduct the station as far as practicable in cooperation with the Alaska Agricultural College and School of Mines. It is desired to conduct investigations at the college in crossing caribou with reindeer and experiments in wintering reindeer on range forage other than lichens, as well as to make detailed plant studies and experiments in interior grazing. It is also desired to maintain under observation a small experimental herd in an inclosure within the agricultural college grounds. Cooperative studies in range management, forage, and reindeer breeding should be of material aid in the development of the reindeer industry in the Territory.

Caribou-breeding experiments.—After considerable effort 10 young caribou bulls have been placed on Nunivak Island for breeding experiments. All reindeer bulls will be eliminated from this herd and studies made of the effect on the strain of reindeer by the addition of the caribou bulls. The animals were captured and held until spring in a reindeer herd near Kokrines and then transported down the Yukon River on a barge as far as Old Hamilton, below Holy Cross, under the supervision of a bureau agent, and from that point to Nunivak Island on the bureau's schooner *Hazel*, used in reindeer work along the Bering Sea coast. In the contract for the capture of the caribou bulls for this experiment they were to be tamed and halter broken so as to lead readily. This was done without difficulty. These young bulls were distinctly larger than reindeer bulls of the same age. They were also more heavily boned than the reindeer, which should be helpful in giving the crossbred animals a heavier frame and one less subject to the injury in handling so frequent among reindeer.

The manuscript was completed during the year for a second bulletin on reindeer grazing and range management in Alaska, to bring up to date the investigations on that subject.

STOCK GRAZING ON THE ALEUTIAN ISLANDS

Owing to a comparatively mild, humid climate, there is excellent forage production on most of the Aleutian Islands, although climatic conditions are such that trees and large shrubs do not grow there. The forage

production has interested certain stock growers, and eight permits have been issued by the Secretary of Agriculture to companies and individuals permitting the use of several of the islands for grazing sheep and other livestock. When properly cared for in winter, sheep thrive well on the islands and produce a heavy yield of wool. Heavy losses were experienced at first among sheep placed on the western end of Unalaska Island, but these difficulties are being overcome, and one of the flock owners reports practically 100 per cent increase of lambs during the spring of 1925. Plans are being made to increase largely the herds on the islands in the spring of 1926. Should the present favorable outlook be confirmed there will be opportunity on the islands for several hundred thousand sheep, which will thus render useful a considerable number of islands which are otherwise from an economic point of view of comparatively little value.

GAME AND BIRD REFUGES

The number of game and bird refuges under the jurisdiction of the bureau is 69, to which will be added the Upper Mississippi River Wild Life and Fish Refuge, the acquisition of which has been authorized by Congress. Inspections were made of the 5 big-game preserves and of several of the 64 bird refuges.

BIG-GAME REFUGES

The report on the status of the pronghorned antelope on the Federal big-game refuges and on other areas throughout western United States, Canada, and Mexico was in press at the close of the year and will appear as Department Bulletin No. 1346. The census of antelope for this bulletin gives a total of about 30,000 existing on this continent early in 1924, a good basis for their conservation.

Nine antelope were shipped in September to the National Bison Range, Mont.; 10 to the Niobrara Reservation, Nebr.; and 12 to the Grand Canyon National Park, Ariz.; all from Reno, Nev., collected on the open range under authorization of the Governor of Nevada. This is the first time that antelope fawns have been captured in considerable numbers for restocking purposes so promptly after birth, and the experiment was successful. A few of the fawns injured or killed themselves while in captivity, but the majority survived in fine condition.

The principal activity during the year on the big-game refuges was the disposal of surplus buffalo and elk at the National Bison Range, Mont.; Wind Cave National Game Preserve, S. Dak.; Niobrara Reservation, Nebr.; and Sullys Hill National Game Preserve, N. Dak. Some of the animals were sold for breeding or exhibition purposes, including 40 buffalo from the Bison Range to start a herd on a large

estate in central California, but the greater number for their meat, owing to a lack of demand for them alive. The sale of surplus animals from the four fenced refuges netted an amount within a few hundred dollars of the cost of their administration.

The accompanying tables show the number of big-game animals on the reservations maintained by the Biological Survey:

Big-game animals on refuges administered by the Biological Survey at the close of the calendar years from 1916 to 1925 (in 1925 to June 30 only)

Year	Buffalo	Elk	Antelope	Mule deer	White-tailed deer	Mountain sheep	Total
1916	206	165	47	2	3		423
1917	251	205	57	2	6		521
1918	311	261	55	15	8		650
1919	381	345	54	21	9		810
1920	431	433	65	27	5		961
1921	508	519	91	54	21		1,193
1922	603	¹ 608	21	¹ 52	¹ 31	15	1,330
1923	717	¹ 657	16	¹ 62	¹ 27	20	1,499
1924	675	¹ 794	25	¹ 82	¹ 27	28	1,631
1925	723	¹ 902	30	¹ 80	¹ 27	¹ 38	1,800

¹Estimated.

Distribution on June 30, 1925, of big-game animals on refuges administered by the Biological Survey

Kind of game	Bison Range	Wind Cave	Niobrara	Sullys Hill	Total
Buffalo	532	121	58	12	723
Elk	¹ 600	¹ 200	59	¹ 43	¹ 902
Antelope	8	12	10		30
Deer, mule	¹ 80				¹ 80
Deer, white-tailed	¹ 25		1	1	¹ 27
Mountain sheep	¹ 38				¹ 38
Total	1,283	333	128	56	1,800

¹ Estimated.

National Bison Range, Mont.—It was estimated near the end of June, 1925, that this range contained 532 buffalo, of which 64 are calves of this season, 600 elk, 80 mule deer, 25 white-tailed deer, 38 mountain sheep (20 adult animals, 8 yearlings, and 10 lambs of this season), and 8 antelope. The figures given for buffalo are approximately correct, but for elk, deer, and lambs in the herd of mountain sheep they are only estimates, since no definite count could be made.

The count of buffalo on June 30 showed 64 living calves and 8 dead, compared with 100 calves living at the same time last year. One hundred and fifty-two buffalo bulls and 24 cows, surplus animals in the herd, were killed and disposed of as meat during the fall and winter, and 45

living buffalo were shipped to other parks and ranches for breeding and exhibit purposes. Three bulls, 4 cows, and 13 calves (including those still-born) died on the range.

The buffalo herd is now under control, so it can be moved readily from one part of the range to another. Two employees of the bureau penned two divisions of the herd, totaling 425 animals, the first day that the work of corralling was undertaken, and while in the corrals the animals could be moved from one pen to another and one or more could be separated from the herd at any time. It has even been possible to milk a couple of the cows.

Three experimental elk drives were made during the progress of corralling the buffalo, and it is believed that

after trap corrals for the elk are completed it will be possible to pen a considerable percentage of them. Elk calves seem to be numerous, and there is one albino yearling on the range. Losses in the elk herd during the year so far as known were two bulls and one cow.

Because of the difficulty of making an accurate count no increase is reported in the number of deer on the range, but it is believed that each year practically as many are lost through their jumping the outside fences as are raised.

So far as known no losses occurred in the band of mountain sheep. Ewes with lambs have been seen in the rugged section favored by sheep, but no complete count of the lambs was possible.

The antelope received at the range from Nevada in September are doing well and have the run of the pasture east of headquarters, which includes 3 or 4 acres of alfalfa.

Of birds on this reservation, Chinese pheasants and sharp-tailed grouse seem to have hatched well, but only one or two pairs of Hungarian partridges were seen during the spring, and wild ducks were fewer last fall and winter than during the previous year. The increased forage growth has given all birds much better food and cover.

Wind Cave National Game Preserve, S. Dak.—Game animals on this refuge number 121 buffalo, including 17 calves; approximately 200 elk and 12 antelope. Two old mule deer formerly on the refuge were not seen during the year. All the animals are in excellent condition and an extremely rainy season has produced better pasturage for them than at any time in 10 years.

During the winter 17 buffalo and 42 elk were killed and disposed of as meat, and 3 buffalo and 9 elk were transported to various parts of the country for exhibition and restocking purposes. Two buffalo and 5 elk died from natural causes, and 2 bull elk and 5 cows were killed accidentally. One antelope died last summer, and 1, a tame buck from Nevada, was added. The antelope are doing well and there are at least 5 fawns in the band.

Elk Refuge, Wyo.—During the summer of 1924, 452 tons of hay were harvested and stacked on this refuge. This was far less than a normal crop, because of the dry summer and lack of sufficient water for irrigation. There were 683 tons left over from the previous year, however, and the

State had on hand 618 tons. The State later purchased 581 tons and pasture rights to 400 acres, so that at the beginning of the winter 2,334 tons of hay were available for feeding the elk coming to the refuge and vicinity during the winter and additional pasturage areas provided.

On October 10 a heavy three-day fall of snow forced many elk down from the mountains into the valleys, and the first band, 5 in number, arrived at the refuge on October 12. During the next few days several hundred appeared, and in January approximately 5,500 were on the feeding grounds, eating an average of 16 tons of hay a day. During the winter the elk were fed approximately 1,189 tons, of which 628 tons were Government owned and 561 tons the property of the State. Many of the elk left the feeding grounds and scattered over the refuge and adjoining ranches during the latter part of January, when the weather moderated to an unusual extent for that time of year, with warm south winds and rainstorms melting much of the snow. Some of the animals trailed back to the foothills, where they found sufficient forage during the rest of the winter, and the quantity of hay fed was diminished accordingly. The weather continued mild during the remainder of the winter, and feeding at the refuge ended on March 28. About 507 tons of hay in the stack remain on hand at the refuge, and the State has 638 tons available for next winter.

Ranches in the vicinity of the refuge, aggregating 1,760 acres, have recently been purchased by the Izaak Walton League of America, and will make additional land available to the elk and increase materially the hay harvested for feeding them next winter. A count of the elk in the Jackson Hole herd made in February and March by employees of the Forest Service, State game commissioners, and the warden of the refuge showed a total of 19,483 in the region. The fawn crop the spring of 1925 was a large one, and the southern Yellowstone elk herds on June 30, 1925, probably numbered not less than 25,000 animals. It is probable, therefore, that an extremely hard winter in the near future would bring more than 12,000 of these animals into the valley for feed, most of them to the elk refuge. If so large a number should have to be fed over a 90-day period, it is estimated that more than 3,700 tons of hay would be required.

Sullys Hill National Game Preserves, N. Dak.—At this refuge are 12 buffalo, in-

cluding 1 calf of this season, approximately 43 elk, and 1 white-tailed deer. All are in excellent condition, and the grass for them on the refuge is plentiful. A 4-year-old buffalo bull was presented to the City Park at Minot, N. Dak., and 2 surplus buffalo and 20 elk were killed and disposed of as meat.

Game birds in captivity at this refuge include: Six Canada geese, approximately 75 mallard ducks, 5 wood ducks, 6 adult Chinese pheasants, from which there has been an increase of 20 this season, and 1 golden pheasant.

A new road 17 miles long is being constructed between Devils Lake, N. Dak., and a point on the Federal-aid road in Benson County north of Sheyenne known locally as the Devils Lake-Fort Totten Highway, and the Biological Survey is cooperating with the Bureau of Public Roads in the construction of a portion of it which runs through the refuge. During the year 8,798 persons visited the refuge, and the new highway will undoubtedly greatly increase the number.

Improvements completed during the year include a winter bird house for water birds, with an acre and a half about it cleared and fenced for a bird yard, erection of additional nesting boxes for tree-nesting ducks and for song birds, and the construction of dams to make two ponds for the ducks. A pavilion was built on the picnic grounds for visitors to the reservation, the parking grounds were enlarged, and various minor improvements made.

Niobrara Reservation, Nebr.—The game animals on the reservation on June 30 included 58 buffalo; 59 elk, besides the calves of this year which have not yet been counted; 10 antelope, received in September from Nevada and in a thriving condition; and 1 white-tailed deer, which is the constant companion of the antelope. Nine surplus animals, 2 buffalo and 7 elk, were killed and dressed for market during the year.

In March, 6 wild turkeys (2 gobblers and 4 hens) were received from the Wichita Game Preserve, Okla., and placed in temporary pens until May, when they were turned out on the reservation. Prairie chickens and sharp-tailed grouse are numerous, and many nests have been found on the prairie. Two broods of grouse were reared in the alfalfa close to headquarters. As it had been four winters since they had suffered much loss, the quail were plentiful. Three combined shelters and feeding stations

were provided, and quail feeding continued throughout the winter.

The Nebraska Bureau of Fish and Game, under authority from this department, built three temporary earth-work dams across the spring runs, creating three ponds in which young trout and bass have been placed, in an experiment which it is hoped will result in furnishing a valuable addition to the fish production of the State.

BIRD REFUGES

Regulations pertaining to the collection of birds and their nests and eggs on Federal bird refuges for scientific and propagating purposes were amended by the Secretary to permit the killing of predatory animals and birds of prey by employees of the Biological Survey, in accordance with the laws of the State or Territory in which situated and at such times as the chief of bureau may designate. Conditions on the 64 bird refuges administered by the Biological Survey are not detailed in the present report. A list of these refuges, together with bird and game refuges on other national reservations, has been revised during the year and will be available in mimeographed form shortly.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

A bill approved by the President on June 7, 1924, authorized the appropriation of \$1,500,000 for the purchase of overflowed lands on both sides of the Mississippi River lying within Illinois, Iowa, Wisconsin, and Minnesota for a distance of about 300 miles between Rock Island, Ill., and Wabasha, Minn., to form a wild-life and fish refuge, the administration of the bird, mammal, and plant life to be by the Department of Agriculture through this bureau, and the administration of the fish, fresh-water mussels which are the basis of an extensive pearl-button industry, and other aquatic life to be under the Bureau of Fisheries of the Department of Commerce.

At the last session of Congress \$375,000 was appropriated for use during the fiscal year beginning July 1, 1925, for initiating the purchase of lands for the formation of this refuge. The great importance of setting aside this area mainly for the benefit of migratory wild fowl and the game fishes of the upper Mississippi Valley and saving them for posterity was called to the attention of the public by the Izaak Walton League, which gave the project such enthusiastic backing that Congress responded

favorably to their desires. There is a fine opportunity here for maintaining a superb wild-life refuge, a portion of which will be held strictly as inviolable sanctuaries where the various forms of wild life may rest undisturbed. Other parts will be open to the public for shooting and fishing to the full limit possible with maintaining the purposes of the refuge.

MIGRATORY-BIRD TREATY AND LACEY ACTS

The beneficial effect of the migratory-bird treaty act in increasing the supply of migratory wild fowl continues to impress observers and to make friends of the former opponents of the law. The economic importance of the migratory birds of the United States, including a potential food value of many millions of dollars annually, justifies the widespread interest in their preservation which is manifest in all parts of the country. Conservationists and sportsmen are disturbed, however, over the future of the birds because of the fact that drainage operations continue to destroy their breeding, feeding, and resting places, and because there is an insufficient number of Federal wardens to enforce the law satisfactorily. The latter condition has resulted in an increased number of violations, including hunting in close seasons, market hunting, power-boat shooting, and wanton destruction of wood ducks, swans, and other rare and valuable birds for which the law provides continuous close seasons.

COOPERATION

In the administration of the Federal game laws and other related activities the Biological Survey has gained the cooperation of State game officials, conservation organizations, and sportsmen in practically all parts of the country. This continued friendly assistance is appreciated, especially since the funds for the enforcement of the migratory-bird treaty act are so limited that the successful enforcement of the law rests on such cooperation.

Cooperation in the assembling of data made possible the prompt publication of the annual poster on open seasons for game, the Farmers' Bulletins on game laws and laws relating to fur animals, and the annual circular containing a directory of officials and organizations concerned with the protection of birds and game. Considerable expense in printing the

game-law bulletin was saved by issuing as a separate publication and sending to a more limited number of persons the text of Federal laws relating to game, which until this year has formed part of the game-law bulletin.

Statistics of hunting licenses and the revenue derived from them by the several States were compiled by the bureau and made one of the tabular statements in the latest Yearbook of the department. The figures indicate that 4,307,066 resident and 32,831 non-resident hunting licenses were issued for the season 1922-23, from which the States received on the average slightly more than \$1 each. The figures for the season 1923-24, not yet published in tabular form, show that 4,357,410 resident and 35,350 nonresident hunting licenses were issued.

MIGRATORY - BIRD TREATY - ACT ADVISORY BOARD

The advisory board under the migratory-bird treaty act held its annual meeting in Washington on December 10, 1924, with 14 members present. Numerous recommendations for changes in the regulations received during the year were considered by the board, the advice and suggestions of which were very helpful in reaching decisions as to policies to be adopted. As the Biological Survey was engaged at the time of this meeting in collecting information as to present wild-fowl conditions, a number of matters were left to be decided through correspondence when the facts on which to base a decision were made available early in 1925.

Among the changes in regulations submitted to the board the following were recommended by it to the Secretary: A change in the season for hunting waterfowl in Texas, Idaho, and eastern Oregon; a change in the shorebird season in Idaho and eastern Oregon; and the establishment of an earlier season for hunting mourning doves in South Carolina. These recommendations were approved by the Secretary and the necessary amendments to the regulations are now in effect.

BAG LIMITS

During the year the bureau was urged by a number of conservationists to bring about an immediate reduction of the daily bag limits on wild ducks and geese, contention being made that the numbers of wild fowl have been so greatly reduced by hunting that the species would be in grave danger of early extermination if the recommendations were not followed. This

proposition was considered at the National Conference on Outdoor Recreation held in Washington in May, 1924, and the executive committee of the conference requested the Department of Agriculture to investigate the present status of migratory wild fowl and to gather data to be used as a basis for appropriate action should reductions of bag limits be found necessary.

Acting on this request the Biological Survey, which already had a large volume of information on the subject, began a nation-wide investigation, and by means of a questionnaire which was sent to State game commissioners, sportsmen, conservation societies, and many of the bureau's field representatives, and others, and which was also published in many sporting and outdoor periodicals, obtained much additional information relative to the abundance of wild fowl. The data gathered came from practically every section of the country and indicated that wild ducks and geese had shown a gratifying increase and that there was no ground for fearing that they were in danger of extermination. With few exceptions the heads of State game departments asserted that these birds had increased in numbers.

The Biological Survey realizes its responsibility to safeguard our migratory wild fowl from undue depletion in numbers and will continue its vigilance over the wild-fowl conditions, and will promptly recommend a reduction of bag limits whenever such action is needed.

PERMITS TO KILL INJURIOUS BIRDS

A small number of complaints are received each year alleging serious injuries to crops or other interests by migratory birds. Exercising his authority under regulation 10 of the migratory-bird treaty-act regulations, the Secretary issued an order during the year permitting growers of small fruits in Oregon and Washington, members of their immediate families, and bona fide employees to kill Lewis woodpeckers when seriously injurious to pears, apples, and small fruits, such permits to be countersigned by the chief official of the State in charge of the enforcement of fish and game laws, or his authorized representative. The officials in these States use such authorizations sparingly, and consequently few permits to kill migratory birds have been issued.

An order was also issued authorizing the commissioner of inland fish and game of the State of Maine and

his regular full-salaried employees to kill merganser ducks and great blue herons for the purpose of protecting game fish in the rivers, lakes, and streams within the State. This order was based on the results of investigations conducted by the Biological Survey, already mentioned, which showed that these birds were very destructive to trout and other game fish in some localities. Such permits ordinarily have no serious effect on the total number of these birds, but the action which can be taken under them unquestionably saves large numbers of game fish.

VIOLATIONS OF THE TREATY ACT

There were 489 cases of violation of the migratory-bird treaty act pending on July 1, 1924, and during the fiscal year 570 more cases were transmitted for prosecution. Of the total of 1,059 cases, 530 were terminated by convictions, 26 were nolle prossed, 69 were dismissed, in 7 juries returned verdicts of not guilty, 1 was stricken from the docket, in 3 prosecution was abandoned, leave to file information was denied in 5 cases, in 1 a demurrer to an information was sustained, and 2 were closed by reason of the death of the accused.

Fines ranging from \$1 to \$275 were imposed and totaled \$11,723.68. Defendants also were required in many cases to pay the costs, which sometimes exceeded the amount of the fine. Eighty-five other cases reported by Federal wardens were not forwarded for prosecution because of youthfulness of the accused, insufficient evidence, adequate fines having been imposed in State courts, or other valid reasons. A large number of cases were turned over to State authorities for prosecution where violations of the State game laws were involved. The revenue accruing to the several States as a result of such cooperation was more than \$6,000.

Convictions in Federal courts were distributed as follows: Alabama, 12; Alaska, 1; Arkansas, 11; California, 10; Delaware, 2; Florida, 24; Georgia, 31; Illinois, 103; Indiana, 7; Iowa, 25; Kansas, 3; Kentucky, 13; Louisiana, 7; Maine 3; Maryland, 14; Massachusetts, 1; Michigan, 2; Minnesota, 34; Mississippi, 3; Missouri, 68; Nebraska, 5; New Jersey, 13; New Mexico, 6; New York, 3; North Carolina, 14; North Dakota, 2; Oklahoma, 2; Oregon, 1; Pennsylvania, 2; Rhode Island, 1; South Carolina, 1; South Dakota, 23; Tennessee, 5; Texas, 48; Utah, 2; Virginia, 22; and Washington, 6.

During the year migratory waterfowl, aigrettes, and specimens of mounted birds unlawfully killed or possessed and having a potential market value of about \$5,000, were seized. All of the migratory game birds thus taken and fit for food were given to public hospitals or to public charitable institutions.

The ninth conviction in Federal court for hunting migratory wild fowl from an airplane was obtained in the eastern district of Texas on March 2, 1925, and a fine of \$10 assessed. Seven cases involving this illegal means of hunting still remain undisposed of.

Among other cases of interest terminated during the year were one in Kansas for selling live wild ducks and geese without a Federal permit, \$25; one in Illinois for possessing ducks in storage during the close season and also grebes for the purpose of sale, \$275 and costs; five in Illinois for possessing ducks in storage in close season, \$150 each and costs; one in Illinois for killing a robin, \$25; two in North Dakota for killing ducks in excess of the daily bag limit, \$25 each; two in New Mexico for possessing swans, \$50 each; one in Virginia for killing curlews, \$100; five in Georgia for killing doves in close season, \$50 each; one in Michigan for hunting ducks after sunset, \$50; and one each in Texas and Florida for serving and selling wild ducks in a restaurant, \$100 each. One offender in the eastern district of Virginia charged with trapping two wild ducks was sentenced to jail for two days.

ASSAULTS ON WARDENS

Assaults on Federal game wardens by violators of the Federal law continue to occur. The latest were committed in Illinois, when Federal Wardens Kenneth F. Roahen, of Illinois, and Marquis A. Charlton, of Ohio, were fired on from ambush by a gunner who was later joined by others hunting with him during the close season. The wardens were so severely injured that they could not return to duty for several weeks. Since the passage of the migratory-bird treaty act one Federal warden has been killed and several others assaulted. Such assaults emphasize the urgent need for a Federal statute under which assailants of Federal officers engaged in the discharge of their duties may be adequately punished.

COLLECTING AND OTHER PERMITS

Beginning January 1, 1924, all permits involving the collection and pos-

session of migratory birds except those authorizing the taking of waterfowl for propagation were made valid until revoked, so that the number issued was considerably less than in previous years.

Permits to collect migratory birds and their nests and eggs for scientific purposes numbered 187, and these, with 1,034 previously issued and valid until revoked, make a total of 1,221 outstanding at the end of the year.

A total of 240 scientific possession permits, mainly for taxidermists, were outstanding at the close of the year, 52 of them issued during the year and 188 previously.

Special permits were issued during the year to 76 persons authorizing them to possess and transport, but not to sell, specimens of migratory birds found dead or accidentally killed.

Permits to trap birds for banding purposes numbered 259, which together with 894 issued in the previous year brought the total number outstanding to 1,153.

Ninety permits were issued to 81 persons authorizing the capture of migratory waterfowl for propagating purposes, and 1,192 authorizing the possession, purchase, sale, and transportation of migratory waterfowl and their eggs for the same purposes. Of the 90 permits issued, 66 expired during the year, leaving 24 outstanding. A total of 2,732 permits authorizing the possession, purchase, sale, and transportation of migratory waterfowl and their eggs for propagating purposes were outstanding, 1,540 of these having been issued during the preceding fiscal year.

INTERSTATE COMMERCE IN GAME

One case involving a violation of the Lacey Act was disposed of in Federal court during the year and a penalty of \$25 imposed. Although no new cases were reported for prosecution, extensive cooperative work with State authorities in the enforcement of State laws with reference to fur animals was conducted and was very helpful in reducing illegal activities of poachers. As a result of investigations by Federal wardens either alone or in cooperation with State wardens, evidence involving 1,000 apparent violations of State laws was referred for prosecution in State courts. Services of particular value were rendered the game departments of Minnesota and North Dakota by Federal game wardens, who, on request, were assigned by the bureau to aid special agents of these States at St. Louis,

Chicago, and St. Paul, where about 700 cases of illegal shipments were uncovered.

The experience of the Federal wardens in the Lacey Act work and their intimate knowledge of the activities of many fur dealers and of conditions in the fur trade were of great assistance in the successful outcome of the cooperative investigations. In 64 investigations closed by State authorities during the year, fines and costs totaling \$2,060.55 were imposed and, in addition, contraband furs were seized in some instances. Sixty-five Federal investigations were pending at the close of the year.

Considerable sentiment has been encountered among fur dealers in favor of an amendment to the Lacey Act to authorize Federal wardens to seize illegally transported skins and furs. This would facilitate cooperation with the various State game officials also, and enable the Federal Government to comply with the many special requests for the examination of shipments en route or at destination and seizure of skins taken or shipped illegally. The need of suppressing this traffic is plain, as such illegal shipments are usually of skins of fur bearers taken in States where these animals have become so reduced in numbers by overtrapping that a close season is declared to permit them to increase. Poachers take advantage of this and still further threaten the existence of the species which it is desired to protect.

IMPORTATION OF FOREIGN BIRDS AND MAMMALS

ENTRIES UNDER PERMIT

The importation of foreign birds and mammals continues to show an increase over previous years. The number of permits issued during the year was 981, an increase of 240, and the number of shipments inspected increased from 232 to 239. Seven additional permits were issued for the entry of 214 miscellaneous birds at Honolulu, Hawaii. The total number of birds imported was 451,908, of which 34,470 were entered without permits.

Mammals.—Permits for the importation of mammals included 8,424 foxes from Canada, a great increase over former years, figures for which are as follows: 4,871 in 1924, 2,753 in 1923, 2,064 in 1922, and 1,574 in 1921. These importations, practically all for ranches, indicate the growth of the fur-farming industry in the United States.

Among notable mammals entered during the year was an echidna, from Australia.

Birds.—As a whole, the year showed increasing shipments of birds. On the Pacific coast there has been a marked increase in the receipts at Seattle and a slight increase at San Francisco, the birds entered at both ports being mainly from the Orient.

Importations of game birds included 39,170 Mexican quail, 3,044 Hungarian partridges, and 93 bamboo partridges, but otherwise the number of game birds brought in was comparatively unimportant. The shipment of Mexican quail was the largest since importations from Mexico began in 1910. The demand for Hungarian partridges was heavy, but after a few shipments an embargo was placed on the birds by authorities in Czechoslovakia, the main source of supply, and almost immediately the entries ceased.

Cage birds, as usual, formed the principal part of the importations and consisted chiefly of canaries and parrots. The canaries numbered 310,297 and the parrots 53,964.

Through efforts of some of the larger importers, concessions were obtained from local authorities in Abyssinia permitting the capture and shipment of birds, including several species not hitherto seen alive in the United States. This remote section of Africa, which thus far has been practically a sealed book, has now been opened up and some of its rarities made available for zoological gardens in this country. Among the birds thus imported for the first time, except a few starlings in 1924, were Abyssinian starlings (*Spreo superbus*), Abyssinian barbets (*Trachyphonus margaritatus*), and parakeets (*Agapornis taranta*). Other interesting birds included 4 Pucheran guinea fowl (*Guttera pucherani*) from other parts of Africa, 3 Bennett cassowaries (*Casuarus bennetti*) from New Britain, some bleeding-heart doves (*Phlegoenus luzonica*) from the Philippines, and 8 sand grouse (*Syrhaptes paradoxus*) from Central Asia.

Preliminary investigations with a view to preparing regulations governing the importation of certain cage birds were made during the year for the purpose of preventing losses from overcrowding in shipments. Canaries and most parrots are imported either in separate cages or with only a few birds in a cage, but some of the smaller weaver birds and finches are crowded in such numbers into boxes of various sizes and shapes that losses are unavoidable. Under such cir-

cumstances the weaker or smaller birds are injured by fighting, inability to obtain sufficient food and water, or lack of ventilation. Conditions can probably be radically improved and losses avoided without causing any appreciable hardship on the importers.

Eggs of game birds.—During the year 19 permits were issued for the importation of 2,695 eggs of game birds from foreign countries, chiefly eggs of pheasants from England and from Ontario and British Columbia, Canada; of ducks and grouse from Alberta; and of grouse from Norway. The largest shipments comprised 1,000 pheasant eggs from England, which arrived at New York on June 1; 200 pheasant eggs from Hamilton, Ontario, at Buffalo, N. Y., May 8; and 100 wild-duck eggs from Leduc, Alberta, at Portal, N. Dak., May 15. About half the shipments were English pheasant eggs from Europe or Canada, evidently imported for the purpose of introducing new blood into local stock. The grouse eggs from Norway were consigned to Illinois; the partridge eggs from Alberta to California; the pheasant eggs from England to Ohio; and the duck eggs from Canada to Wisconsin, Louisiana, New York, and Rhode Island.

Mexican quail.—The entry of quail from Mexico, as in 1924, was regulated through permits issued by the Mexican authorities, and instead of being collected near the border the birds were obtained from several of the States in northeastern Mexico. This year the total number to be exported was determined beforehand, concessions were granted to a limited number of shippers, and the destination of the birds stated in the permits. On request from the Mexican authorities, the Biological Survey co-operated in seeing that these conditions were carried out and furnished a report of the importations at the close of the season. The total number of quail brought in was 39,170, the largest number ever imported in a single season. Entries were limited to the two ports of Brownsville and Laredo, Tex., and of the total, 36,390 birds were brought in at Brownsville and 2,780 at Laredo.

The first importation arrived on February 11, and entries continued until the close of the season on April 30. The birds were examined by an inspector of the Bureau of Animal Industry at the port of entry, but no quail disease was reported during the

season. Weekly reports were made on the condition of the birds and the destination of shipments, thus furnishing a more complete check than has hitherto been available on the destination of the entries. Most of the birds were shipped to six States, as follows: Pennsylvania, 5,848; Kentucky, 3,886; Illinois, 7,408; Oklahoma, 4,261; Mississippi, 1,634; Texas, 14,070; and miscellaneous States, 736.

The total number of quail imported from Mexico since shipments began in 1910 is now 229,029. Most of these birds were bobwhites, but a few were scaled quail. Inquiries were received this year regarding the importation of the Gambel quail from Sonora, and valley quail from Lower California, but no importations actually crossed the border.

PROHIBITED SPECIES

Two cases of entry of prohibited species occurred during the year. A newspaper clipping was received from a western correspondent containing the illustration of a mongoose said to be in the possession of a student at the University of Wisconsin. The matter was at once taken up with the Customs Service, and through the collector of customs at Milwaukee an investigation was made and the animal located, identified, and promptly killed. Further investigation disclosed that this mongoose had been entered on or about February 11, 1924, under the name "honey bear," at Brooklyn, N. Y., and had subsequently been presented to the student.

Early in June, 1925, application was received for the entry of five mongooses, all males, which had been brought from Calcutta by the captain of a steamer for the owner of a private game preserve in New York. The consignee was advised that the animals could not be landed, and on June 13 they were reshipped to India.

These are the first cases of prohibited species reported for 10 years (not counting a Philippine paradoxure, which was killed in California in 1923), the last ones occurring in 1914. One was a mongoose discovered at Philadelphia in November, and the other one at San Francisco a few weeks later. The infrequency of attempts to import the mongoose and other proscribed species indicates continued vigilance on the part of officers of the customs and general knowledge of the existence of the law prohibiting such entries.

REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS,
Washington, D. C., October 15, 1925.

SIR: I have the honor to submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1925, covering briefly the work done in connection with the construction of Federal aid and national forest roads, and, more completely, those functions of the bureau which are provided for by the act making appropriations for the Department of Agriculture. A more complete report of the Federal aid and national forest road work will be made subsequently as provided in section 19 of the Federal highway act, approved November 9, 1921.

Respectfully,

THOS. H. MACDONALD,
Chief of Bureau.

Hon. WM. M. JARDINE,
Secretary of Agriculture.

FEDERAL-AID HIGHWAYS

By completing 11,328.6 miles of Federal-aid roads during the fiscal year 1925 the cooperating Federal and State governments established a new record. The greatest mileage previously completed in any one fiscal year was the 10,247 miles completed in 1922. The new record exceeds by 30 per cent the mileage completed in the fiscal year 1924, and by more than 50 per cent the aggregate mileage completed during the first five years of work under the Federal-aid plan.

The year's work brings the total of mileage completed since the passage of the first Federal-aid road act in 1916 up to 46,485.5 miles; and in addition to the mileage completed a great deal of work has been done on the 12,462.6 miles which at the close of the year were under construction. The

program of work thus far undertaken includes the above mileage completed and under construction and an additional 2,181.6 miles approved for improvement with Federal aid but not yet placed under construction. Including this latter mileage the program of Federal and State cooperation in road building as definitely planned or completed to date involves 61,129.7 miles, of which all but 3,570 miles undertaken prior to the passage of the Federal highway act in 1921 are included in the interstate or Federal-aid highway system designated in accordance with the provisions of that act.

FEDERAL-AID HIGHWAY SYSTEM TWO-THIRDS IMPROVED

The mileage of the Federal-aid highway system is limited by law to

200,349 miles, which is 7 per cent of the total mileage of highways in the United States at the time of the passage of the Federal highway act. Up to the present the system as designated includes only 178,797 miles. Of this mileage, as indicated above, approximately 57,560 miles has already been improved or undertaken for improvement with Federal aid. As the States alone, without Federal assistance, have completed or have under construction an additional mileage on the system amounting to over 65,000 miles, it will be seen that approximately two-thirds of this system, designated since 1921, is already completed or under construction. When the system was designated it was hoped that its improvement could be completed within 10 years. At the present rate it is apparent that this hope will be realized and that within five more years, if nothing happens to retard the progress, there will be a continuous interstate highway system connecting every city of 5,000 population or larger, and every section of it improved to a degree consistent with the density and character of the traffic.

The year's mileage completed constitutes a varying percentage of the Federal-aid highway system in the several groups of States. As the designated system is in all States practically the same percentage of the total mileage of highways, and as in all States it includes the most important highways, the ratio of the mileage of Federal-aid roads completed during the year to the mileage of the system in each State or group of States may be taken as the index of the rapidity with which the highways of the section are being improved with Federal aid.

Analyzing the year's record in this way it appears, as shown in Table 1, that the most rapid progress toward the completion of the Federal-aid system with Federal participation was made in the West South Central States,¹ where the mileage completed

during the year was 8.6 per cent of the total mileage of the system. In these States the progress of the co-operative construction would, if continued at the same rate, without other construction, result in the completion of the Federal-aid system in less than 12 years.

Compared in the same manner with the mileage of the Federal-aid system the year's progress in the co-operative work by other groups of States is indicated by the percentages shown in the third column of Table 1. Ranked in the descending order of percentage improved during the year the several groups are: West South Central, 8.6 per cent; East South Central, 8.2 per cent; Mountain, 7.6 per cent; South Atlantic, 6 per cent; Middle Atlantic, 5.8 per cent; West North Central, 5.5 per cent; East North Central, 5 per cent; Pacific, 4.9 per cent; New England, 4.4 per cent.

Forty-three per cent of the mileage completed during the year was built in the 16 States which comprise the East and West South Central and Mountain groups. These States, almost without exception the largest in the country, include 49 per cent of the total land area of the United States. Somewhat later in commencing the improvement of their roads than the other States, they are now making rapid progress in the building of their main highways with Federal aid. Fortunately their highway traffic is still considerably lighter than in other States and they are able, therefore, to build a greater mileage of satisfactory highways at a given cost than the other States. This is indicated by the fact that while their completed mileage was 43 per cent of the year's total, the total cost of the roads completed was only 35 per cent of the total cost of all roads completed with Federal aid during the year.

East North Central States: Ohio, Indiana, Michigan, Illinois, Wisconsin.

East South Central States: Kentucky, Tennessee, Alabama, Mississippi.

West North Central States: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

West South Central States: Arkansas, Louisiana, Oklahoma, Texas.

Mountain States: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada.

Pacific States: Washington, Oregon, California.

¹ The various groups of States referred to are as follows:

New England States: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.

Middle Atlantic States: New York, Pennsylvania, New Jersey.

South Atlantic States: Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.

TABLE 1.—Federal-aid mileage completed during the fiscal year 1925 compared with the mileage of the Federal-aid highway system by groups of States

Group of States	Federal-aid roads completed	Federal-aid highway system	Portion of Federal-aid system improved with Federal aid
	<i>Miles</i>	<i>Miles</i>	<i>Per cent</i>
New England.....	256.2	5,789	4.4
Middle Atlantic.....	571.4	9,879	5.8
South Atlantic.....	1,272.7	21,155	6.0
East North Central..	1,293.7	25,740	5.0
West North Central..	2,561.3	46,435	5.5
East South Central..	1,149.8	14,020	8.2
West South Central..	2,096.1	24,282	8.6
Mountain.....	1,626.2	21,308	7.6
Pacific.....	501.2	10,189	4.9
Total.....	11,328.6	178,797	6.3

FEDERAL AID A VITAL FACTOR IN CENTRAL AND MOUNTAIN STATES

The degree to which the States of the several groups are dependent upon Federal participation to enable them to carry on the work of highway improvement is indicated by Table 2 in which the mileage of Federal-aid roads completed during the fiscal year 1925 is compared with the total mileage of highways constructed under the supervision of the State highway departments during the calendar year 1924. Unfortunately the data are not available which permit this comparison to be made on the basis of exactly the same period, but the difference in time is not great enough to be material.

It is apparent from Table 2 that the Federal assistance is a very important factor in the East and West South Central States and the Mountain States where the Federal-aid roads constitute from two-thirds to three-quarters and more of the annual program of construction. In the Middle Atlantic and East North Central States the percentage of roads built without Federal assistance is highest, being more than two-thirds of the annual program in each case, whereas, for the country as a whole the Federal-aid program is practically half of the annual construction program carried on under the State highway departments.

While the Federal aid is thus shown to be in all States a considerable factor, invaluable to some and helpful to others, the fact that in all groups of States from a fifth to two-thirds of

TABLE 2.—Federal-aid mileage completed in fiscal year 1925 compared with total mileage completed in 1924 by the State highway departments

Group of States	Federal-aid mileage completed, fiscal year 1925	Mileage completed by State highway departments, 1924	Ratio of Federal aid to total State program
	<i>Miles</i>	<i>Miles</i>	<i>Per cent</i>
New England.....	256.2	622.9	41.2
Middle Atlantic.....	571.4	1,878.1	30.4
South Atlantic.....	1,272.7	3,240.7	39.3
East North Central..	1,293.7	4,259.3	30.4
West North Central..	2,561.3	5,079.3	50.5
East South Central..	1,149.8	1,525.6	75.5
West South Central..	2,096.1	3,187.1	65.7
Mountain.....	1,626.2	2,075.3	78.5
Pacific.....	501.2	1,295.7	38.6
Total.....	11,328.6	23,164.0	49.0

the highways improved under the supervision of the State highway departments are built with State funds entirely without Federal participation is sufficient to indicate that the offer of Federal assistance has not had the effect of inducing the States to spend a greater sum for highway improvement than they would otherwise have found expedient.

THE YEAR'S RECORD BY TYPES OF CONSTRUCTION

The mileage completed during the fiscal year, classified according to type of construction, is shown in Table 3.

TABLE 3.—Mileage of Federal-aid roads completed in fiscal year 1925, by types of construction

Class and type of construction	Completed during fiscal year 1925		
	By types	By classes	
Low:	<i>Miles</i>	<i>Miles</i>	<i>Per cent</i>
Graded and drained..	2,064.1	6,985.8	61.7
Sand-clay.....	718.8		
Gravel.....	4,202.9		
Intermediate:			
Water-bound macadam.....	129.2	1,041.1	9.2
Bituminous macadam.....	911.9		
High:			
Bituminous concrete..	341.3	3,255.0	28.7
Portland-cement concrete.....	2,806.4		
Brick.....	107.3		
Bridges.....	46.7	46.7	.4
Total.....	11,328.6	11,328.6	100.0

Classified in a similar manner by groups of States the completed mileage is analyzed in Table 4.

TABLE 4.—*Mileage of Federal-aid roads completed in fiscal year 1925, by classes and groups of States*

Group of States	Class of construction							
	Low		Medium		High		Bridges	
	<i>Miles</i>	<i>Per cent</i>	<i>Miles</i>	<i>Per cent</i>	<i>Miles</i>	<i>Per cent</i>	<i>Miles</i>	<i>Per cent</i>
New England.....	48.8	19.0	113.6	44.4	91.9	35.8	1.9	.8
Middle Atlantic.....	1.6	.3	50.4	8.8	519.3	90.9	1.1	-----
South Atlantic.....	671.8	52.8	124.3	9.8	469.6	36.9	7.0	.5
East North Central.....	224.9	17.4	71.0	5.5	996.4	77.0	1.4	.1
West North Central.....	2, 110.5	52.4	43.2	1.7	402.6	15.7	5.0	.2
East South Central.....	753.2	65.5	292.3	25.4	102.5	8.9	1.8	.2
West South Central.....	1, 346.9	64.2	320.6	15.3	406.4	19.4	22.2	1.1
Mountain.....	1, 494.7	91.9	5.0	.3	120.8	7.4	5.7	.4
Pacific.....	333.4	66.5	20.7	4.1	145.5	29.1	1.6	.3
Total	6, 985.8	61.7	1, 041.1	9.2	3, 255.0	28.7	46.7	.4

These tables give evidence of the economy that has been exercised in the choice of types of construction. Almost a fifth of the roads built during the year were merely graded and drained; three-fifths were of the character described as low types. As will be seen from Table 4 the roads of this character have been built in those sections where traffic is still comparatively light; and in those sections they are regarded as merely the first stage of a more durable improvement which will follow as the traffic demands require it. The heavy mileage of the gravel type is especially noteworthy. This type has been found to give excellent service under automobile and light truck traffic to a maximum of about 500 vehicles a day, and it has the further advantage that it adds greatly to the life of any pavement which may subsequently be laid upon it. As suitable gravel is widely distributed in nature this type can be built at a very reasonable cost in most places.

The high-class pavements of bituminous concrete, Portland cement concrete, and brick are shown to have been constructed mainly in the Middle Atlantic, East North Central, New England, and Pacific States. It is only in these States that the traffic has developed to the point where such expensive surfaces are generally required even on the main roads. The small mileage of waterbound macadam constructed is due to the fact that this type, formerly the standard, is not suitable for motor vehicle traffic. In practically all cases the roads of this type which have been constructed will be surface-treated with

bituminous material within a year to protect them from the disintegrating action of the pneumatic tires of automobiles.

NEARLY 50 MILES OF BRIDGES COMPLETED

It is especially interesting to note that the bridges completed during this fiscal year reach the impressive total of 46.7 miles in length. All these bridges are more than 20 feet in span and many of them cross major streams. More than a hundred miles of such structures have been completed with Federal aid since 1917 and projects have been approved for the construction of others which will add another 50 miles to the total length.

As stated in the last annual report, the value of Federal participation in highway construction is in no way better exemplified than in the construction of these bridges. In many cases the bridges are built at points where it has not hitherto been possible to construct them because of a lack of local funds for the purpose or because of the difficulty of obtaining joint action by counties and States in the numerous cases in which the structures span streams which form the borders of counties or States.

The careful study of lines of travel which has been made by the State and Federal authorities has developed clearly the points at which such bridges are required and the coordinating influence of the Federal Government has been the means of obtaining action toward their construction. The more important structures completed during the year are listed in Table 5.

TABLE 5.—Federal-aid bridges completed during the fiscal year 1925 at a total cost of \$75,000 or more

State	Location between towns	Stream	Length Miles
Alabama	Tuscaloosa and Northport	Black Warrior River	0.1
Colorado	Pueblo and Avondale	St. Charles River	.5
Do	Deita and Grand Junction	Gunnison River	.4
Florida	Chattahoochee and Sneads	Apalachicola River	.2
Georgia (interstate)	Tooea, Ga., and Westminster, S. C.	Tugalo River	.1
Georgia	Waycross and Blackshear	Satilla River	.9
Idaho	Spalding and Lewiston	Clearwater River	.1
Idaho (interstate)	Payette, Idaho, and Ontario, Oreg.	Snake River	.04
Illinois	East of Carlyle	Kaskaskia River	.6
Do	Momence and Kankakee	Kankakee River	.1
Indiana	Clay City and Jasonville	Eel River	.3
Kansas	At Drury	Chickaskia River	.2
Louisiana	Jennings and Crowley	Mermentau River	.6
Mississippi	West of Greenwood	Yazoo River	.1
Missouri	Booneville and New Franklin	Missouri River	.5
Do	Linn and Mount Sterling	Gasconade River	.1
New Mexico	Tucumcari and Logan	Canadian River	.4
North Carolina	Wilmington and Southport	Brunswick River	.1
Oklahoma	Fort Smith and a point south of Wister	Poteau River and Caston Creek	.2
Do	Gore and Vian	Illinois River	.1
Do	Blackwell and Kildare	Chickaskia River	.1
Do	El Reno and Kingfisher	Canadian River	.1
Oregon	Near Winchester	North Umpqua River	.2
South Carolina	Spartanburg and Gaffney	Pacolet River	.1
South Dakota	Mobridge and McIntosh	Missouri River	.3
Texas	Austin and Bastrop	Colorado River	.4
Washington	Olympia and Port Angeles	Hama Hama River	.1
Total			6.94

Among the more important structures now under construction are the bridges over Raritan Bay near Perth Amboy, N. J., and two bridges over the Missouri River in Missouri. The New Jersey structure, which is 80 per cent complete, stands at one of the principal approaches to New York City. It is an essential link in the Federal-aid highway system and is especially important to traffic between the coastal section of the State and the cities of Elizabeth, Newark, Jersey City, and New York. The bridge with its approaches is 1.6 miles in length and will cost, according to the estimate, approximately \$4,000,000, of which the Federal Government, because of its special and peculiar interest, will pay approximately one-third.

The special importance of the Missouri bridges is evident at a glance to anyone who will examine the map of the State. Extending entirely across the State in an easterly and westerly direction this great stream practically cuts the State in half. To establish highway communication between these sections the Federal-aid program of the State has included four major bridges of which two, one near Waverly and the other near Booneville, have been completed during this fiscal year and two are now under construction. The completed bridges were built at a combined cost of more

than a million dollars with Federal participation to the extent of 50 per cent. Of the two now under construction, one near Lexington will cost alone approximately \$1,300,000 and the other almost \$800,000. The Federal participation in these structures is somewhat less than half the estimated cost.

As the fiscal year closes we are endeavoring to reach an agreement with the States of Arkansas and Tennessee looking to the construction of what will be one of the most important bridges in the country—that across the Mississippi River at Memphis.

FEDERAL EXPENDITURES LESS THAN 10 PER CENT OF TOTAL

The total cost of the 11,328.6 miles completed during the fiscal year was \$242,937,488.57. The Federal share of the cost was \$111,304,737.24. These expenditures were made over the period of approximately two years required to bring the projects to completion. They do not represent the annual expenditure for Federal-aid construction. The actual disbursements of the Federal funds to each State during the year are given in Table 6, from which it will be seen that the total disbursement was \$95,749,998.11. These disbursements were made partly on account of the projects reported

TABLE 6.—*Federal-aid disbursements to States, fiscal year 1925*

State	Federal-aid disbursement	State	Federal-aid disbursement
Alabama.....	\$2,367,059.57	New Hampshire.....	\$553,913.21
Arizona.....	759,664.64	New Jersey.....	1,889,720.46
Arkansas.....	1,835,978.92	New Mexico.....	2,910,090.59
California.....	3,346,816.24	New York.....	4,813,177.91
Colorado.....	1,678,505.39	North Carolina.....	2,087,591.07
Connecticut.....	903,810.44	North Dakota.....	934,328.79
Delaware.....	385,737.26	Ohio.....	2,652,957.54
Florida.....	1,201,584.13	Oklahoma.....	2,852,978.73
Georgia.....	2,494,796.29	Oregon.....	1,091,482.02
Idaho.....	885,245.73	Pennsylvania.....	3,701,190.14
Illinois.....	3,621,054.94	Rhode Island.....	359,281.96
Indiana.....	4,184,160.40	South Carolina.....	1,220,841.20
Iowa.....	1,839,907.52	South Dakota.....	1,856,560.86
Kansas.....	2,917,961.09	Tennessee.....	3,079,450.10
Kentucky.....	1,849,055.70	Texas.....	5,136,128.59
Louisiana.....	1,243,790.76	Utah.....	1,554,844.27
Maine.....	510,283.23	Vermont.....	563,080.01
Maryland.....	621,915.84	Virginia.....	1,878,842.43
Massachusetts.....	1,369,630.31	Washington.....	1,101,796.53
Michigan.....	3,609,501.49	West Virginia.....	630,038.80
Minnesota.....	3,233,220.77	Wisconsin.....	1,325,077.49
Mississippi.....	2,171,302.47	Wyoming.....	1,723,033.50
Missouri.....	4,208,311.64	Hawaii.....	10,657.25
Montana.....	1,142,609.02		
Nebraska.....	1,535,989.82	Total.....	95,749,998.11
Nevada.....	1,900,041.06		

as completed during the year and partly in the form of progress payments for projects still under construction.

As will be seen from Table 6, the Federal expenditure this year closely approaches an annual rate of \$100,000,000. That such a sum does not remotely approach the point of extravagance is indicated by the fact that it is not more than 10 per cent of the whole annual expenditure for highways by all units of government.

In the sparsely settled States of the West the Federal participation is a vital necessity and a definite obligation. The sections of the Federal-aid system in these States partake more of the character of interstate or national roads than of roads for local traffic. The mileage to be improved is so great that without the Federal contribution the work could not be done in a generation; and to this reason there is added the still more compelling one that is involved in the ownership of vast areas of lands by the United States which are not taxable by the States.

But the necessity for Federal participation in highway construction does not lie alone in the Far West, nor even in the Middle West and South. It is even more essential that a continuous and adequate system of highways be built in the more populous sections of the East. There is a

totally erroneous impression that the roads in the East have generally been built. It is true that road improvement was begun in that section at an early date and many miles of road were built, but every mile of the original construction is being rebuilt to meet the requirements of the greatly increased traffic, and the Federal funds are as eagerly used in this section as in any other.

There is a service which should be rendered to the people of these States in particular which can not be rendered by the State governments acting separately and alone. It must be remembered that the population around the borders of the States is no less dense than in their interiors. Between the border populations of contiguous States there is a commerce which is interstate in character, though actually local in range. Nevertheless it can only be served by the unbroken continuation of roads from each State into its bordering States. It is this object, now being rapidly accomplished with Federal assistance, that the several States acting separately and alone could not have accomplished. And the Eastern States have benefited to a marked degree by this Federal service for the very reason that their population is dense and that the number of interstate roads is great. Especially in these States, it must be recognized,

that the influence of the great focal centers of population can not be obstructed at State lines. The city of Boston, for example, is the hub of New England. It centers the trade and traffic of the whole section and the highways to serve this traffic must extend through many States in unbroken continuity.

The expenditure for the roads completed during the fiscal year is analyzed by groups of States in Table 7. From this table it is apparent that the Federal funds are being utilized to practically the full extent permis-

placed under construction a year and a half or two years ago, the Federal payments per mile reflect the provisions of the law then prevailing. An examination of the work now under way would show a still further reduction of the Federal payments per mile. This limitation is felt most keenly in the States of the Northeast. Because of the great density of traffic it is impossible to build adequate highways at a cost which can be shared equally by the Federal Government.

With the exception of the two groups referred to above and the

TABLE 7.—*Analysis of expenditures for Federal-aid roads completed in fiscal year 1925 by groups of States*

Group of States	Total cost of completed Federal-aid roads, fiscal year 1925	Federal aid to completed roads, fiscal year 1925	Average total cost per mile	Average Federal aid per mile	Percentage paid by Federal Government	Proportion of grand total cost	Proportion of grand total of Federal aid	Proportion of area
					<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
New England.....	\$11,244,053.57	\$4,311,674.09	\$43,900	\$16,800	38.4	4.6	3.9	2.1
Middle Atlantic.....	27,187,500.97	9,142,753.40	47,600	16,000	33.6	11.2	8.2	3.4
South Atlantic.....	28,748,770.43	12,752,581.46	22,600	10,000	44.5	11.8	11.5	9.1
East North Central.....	38,834,920.75	17,924,902.51	30,000	13,850	46.2	16.0	16.1	8.2
West North Central.....	37,722,742.38	17,546,687.06	14,700	6,850	46.5	15.5	15.7	17.2
East South Central.....	25,949,235.84	12,374,777.65	22,600	10,750	47.7	10.7	11.1	6.0
West South Central.....	38,160,691.51	16,365,969.28	18,200	7,800	43.0	15.7	14.7	14.4
Mountain.....	21,797,180.90	13,999,018.39	13,400	8,600	64.3	9.0	12.6	28.9
Pacific.....	13,292,392.22	6,886,373.40	26,500	13,750	51.8	5.5	6.2	10.7
Total.....	242,937,488.57	111,304,737.24	21,400	9,850	45.9	100.0	100.0	100.0

sible under the law in all sections. The New England, Middle Atlantic, and East North Central States are shown by this table to have spent 31.8 per cent of the total sum expended for roads completed during the year, and to have received 28.2 per cent of the Federal aid although they constitute only 13.7 per cent of the area of the United States. The States of the Mountain and Pacific groups which include 39.6 per cent of the total land area received only 18.8 per cent of the Federal aid and accounted for only 14.5 per cent of the total cost.

FEDERAL PARTICIPATION LIMITED BY LAW IN EASTERN STATES

The lower percentage of the total cost paid by the Federal Government in the New England and Middle Atlantic States is the result of the limitation placed upon the Federal expenditure per mile of highway. Originally \$10,000 per mile, this limitation was increased in 1919 to \$20,000 and subsequently reduced to \$16,250 for the fiscal year 1923, and to \$15,000 per mile thereafter. As most of the roads completed during the past year were

Mountain and Pacific groups, the Federal participation ranges in all groups from 43 to practically 48 per cent of the total cost, the average for the entire country being approximately 46 per cent. The higher proportion paid in the States of the far West is made possible by the provision of the law which recognizes a greater Federal responsibility in these States because of the large holdings of public land.

Outstanding among the projects which have been made possible by this provision is the Wendover Cut-off in Utah, completed during this fiscal year. This road extending westward from Salt Lake City to the Nevada line across the Great Salt Lake Desert supplies the most difficult and almost the last link in the most direct highway connection between the east and west coasts. Its cost was \$380,000, of which \$284,000 was paid by the Federal Government. Since it passes through a section of the State of Utah that is practically uninhabited it is doubtful whether this essential interstate link ever would have been built but for the Government participation.

MOTOR-VEHICLE TAXES ALONE SUFFICIENT TO MATCH FEDERAL APPROPRIATIONS

That the appropriation of Federal funds on the basis of \$75,000,000 a year does not unduly tax the resources of any of the States is clearly indicated by Table 8, in which it is shown that the State funds required to match the Federal apportionment of a \$75,000,000 appropriation are exceeded by the revenues raised by taxation of motor vehicles and motor fuel in all States except New Mexico.

TABLE 8.—*Comparison of State motor-vehicle revenues and funds required to match Federal appropriations*

State	State funds required to match Federal appropriation of \$75,000,000	Gross State income from motor vehicle license fees and gasoline taxes, calendar year 1924
Alabama.....	\$1,541,870	\$3,693,462
Arizona.....	403,800	1,070,560
Arkansas.....	1,264,164	5,101,775
California.....	1,628,000	19,004,335
Colorado.....	1,068,000	2,984,162
Connecticut.....	474,801	6,047,864
Delaware.....	365,625	908,746
Florida.....	892,878	6,077,610
Georgia.....	1,983,089	7,059,737
Idaho.....	628,000	1,852,564
Illinois.....	3,191,479	11,546,206
Indiana.....	1,938,693	9,028,038
Iowa.....	2,070,396	8,979,170
Kansas.....	2,074,360	4,222,930
Kentucky.....	1,411,607	4,894,317
Louisiana.....	997,262	4,125,668
Maine.....	685,140	2,455,811
Maryland.....	635,783	3,921,375
Massachusetts.....	1,090,118	8,122,166
Michigan.....	2,225,227	12,404,546
Minnesota.....	2,124,151	8,591,853
Mississippi.....	1,291,960	3,173,825
Missouri.....	2,417,727	4,525,914
Montana.....	1,193,000	1,395,615
Nebraska.....	1,581,969	3,597,261
Nevada.....	132,000	344,565
New Hampshire.....	365,625	2,110,031
New Jersey.....	935,082	9,278,428
New Mexico.....	690,000	616,395
New York.....	3,657,096	24,089,241
North Carolina.....	1,699,168	9,143,569
North Dakota.....	1,180,699	1,259,735
Ohio.....	2,789,588	11,685,329
Oklahoma.....	1,415,000	6,712,180
Oregon.....	710,000	7,464,848
Pennsylvania.....	3,360,123	31,196,917
Rhode Island.....	365,625	1,623,604
South Carolina.....	1,052,549	3,338,120
South Dakota.....	965,000	3,273,592
Tennessee.....	1,622,985	4,410,105
Texas.....	4,415,715	14,266,766
Utah.....	229,000	1,170,330
Vermont.....	365,625	1,554,242
Virginia.....	1,449,713	7,104,744
Washington.....	941,000	7,496,831
West Virginia.....	797,295	4,106,531
Wisconsin.....	1,873,308	6,786,485
Wyoming.....	525,000	648,983
Hawaii.....	365,625	-----
Total.....	67,081,920	304,467,082

That, in matching the Federal appropriations, the States do not incur a greater expense for highway improvement is indicated by the fact that, with two exceptions, the disbursements by the State highway departments during the calendar year 1924, exceeded the amount expended on Federal-aid roads, as shown in Table 9.

TABLE 9.—*Approximate disbursements by State highway departments in excess of expenditures for Federal-aid roads, calendar year 1924*

State	State disbursements for other than Federal-aid roads
Alabama.....	\$1,279,000
Arizona.....	1,376,000
Arkansas.....	7,484,000
California.....	14,809,000
Colorado.....	3,050,000
Connecticut.....	7,430,000
Delaware.....	2,823,000
Florida.....	4,724,000
Georgia.....	3,021,000
Idaho.....	1,229,000
Illinois.....	33,571,000
Indiana.....	5,960,000
Iowa.....	12,791,000
Kansas.....	-----
Kentucky.....	9,970,000
Louisiana.....	5,743,000
Maine.....	5,420,000
Maryland.....	8,477,000
Massachusetts.....	9,760,000
Michigan.....	15,650,000
Minnesota.....	7,822,000
Mississippi.....	431,000
Missouri.....	17,469,000
Montana.....	128,000
Nebraska.....	3,189,000
Nevada.....	604,000
New Hampshire.....	2,808,000
New Jersey.....	17,308,000
New Mexico.....	1,589,000
New York.....	33,788,000
North Carolina.....	29,883,000
North Dakota.....	-----
Ohio.....	11,007,000
Oklahoma.....	958,000
Oregon.....	8,359,000
Pennsylvania.....	40,063,000
Rhode Island.....	2,094,000
South Carolina.....	3,037,000
South Dakota.....	1,696,000
Tennessee.....	4,244,000
Texas.....	11,880,000
Utah.....	1,487,000
Vermont.....	1,910,000
Virginia.....	10,771,000
Washington.....	4,699,000
West Virginia.....	12,559,000
Wisconsin.....	5,982,000
Wyoming.....	1,940,000
Total.....	392,272,000

MAINTENANCE THE PARAMOUNT CONSIDERATION

As previously stated, the Federal participation has in no year amounted to more than 10 per cent of the Na-

tion's total expenditure for highways, but the expenditure of these funds under joint Federal and State supervision on a limited system of major highways is rapidly connecting the States and larger communities within the States with lines of highways that are adequately built and properly maintained.

The Federal inspection of maintenance required by the Federal highway act has been of immeasurable benefit to the people of the United States. It is, if possible, more important than the original construction. Every project which has been built in part with Federal funds is inspected at frequent intervals by Federal engineers. Any that show signs of needed repairs are called to the attention of the State authorities by the Federal inspectors, and without exception the defects have been promptly remedied. This is the greatest triumph of the Federal-aid policy. The general policy of local authorities prior to the transfer of control to the State and Federal agencies was to use practically all available funds for new construction, reserving a totally inadequate amount for maintenance. Now, the proper upkeep of the highways is made the paramount consideration.

SUMMARY OF FEDERAL-AID ROAD WORK BY STATES

The construction of Federal-aid roads has now been carried on for nine years. It may therefore be desirable to summarize briefly the results that have been accomplished in each State to indicate the degree to which each has benefited by Federal participation.

Alabama.—The section of the Federal-aid highway system in this State includes 3,872 miles. All but 68 miles of the 1,153.7 miles of Federal-aid road completed are included in the system, the excluded mileage having been constructed prior to the designation of the system. Of the completed mileage 482.2 miles was added during the fiscal year 1925. At the close of the year there were 263 miles under construction and 25 miles approved but not yet under construction. The greater part of the mileage completed is surfaced with gravel or sand-clay, there being 651.1 miles of the former type and 315.9 miles of the latter. There are also 3.2 miles of earth roads graded and drained, 11.6 miles of waterbound macadam, 73.4 miles of bituminous macadam, 86.7

miles of bituminous concrete, and 9.6 miles of Portland cement concrete. The bridges completed have a combined length of 2.2 miles.

The total cost of the roads completed during the fiscal year was \$8,946,220, of which the Federal share was \$4,405,980. The actual disbursement of Federal funds to the State during the year was \$2,367,059.

Arizona.—Arizona's section of the Federal-aid highway system includes 1,498 miles. The mileage of Federal-aid roads completed in the State up to the close of the last fiscal year was 670.5, all but 56 miles of which is included in the Federal-aid system. Of the completed mileage 132.8 miles was added during the last fiscal year. At the close of the year there were also 101 miles under construction and 33 miles approved but not yet under construction. The greater part of the completed system consists of 139.8 miles of graded and drained earth roads and 342.5 miles of gravel roads. In addition there were 55.9 miles of sand-clay, 14.2 miles of waterbound macadam, 16.5 miles of bituminous concrete and 99.4 miles of Portland cement concrete. The bridges completed have a combined length of 2.2 miles.

The total cost of the roads completed during the fiscal year was \$1,685,978, of which the Federal Government paid \$999,603. The actual disbursement of Federal funds to the State during the year was \$759,664.

Arkansas.—The Federal-aid highway system in this State includes 5,007.03 miles. All but 53 miles of the 1,136.9 miles of Federal-aid roads completed up to the close of the year are included in this system, the excluded mileage having been constructed prior to the designation of the system. Of the completed mileage 188 miles was added during the fiscal year 1925. At the close of the year there were 299 miles under construction and 43 miles approved but not yet under construction. Of the 1,136.9 miles of roads completed up to the close of the year 727.3 miles were surfaced with gravel, 3.1 miles with sand-clay, 40.3 miles with waterbound macadam, 61.1 miles with bituminous macadam, 243.4 miles with bituminous concrete and 60.4 miles with Portland cement concrete, the balance of the completed mileage consisting of a total of 1.3 miles of bridges.

The total cost of the roads completed during the year was \$4,713,282, of which the Federal Government paid \$1,766,874. The actual disbursement

of Federal funds to the State during the year was \$1,835,979.

California.—The California section of the Federal-aid highway system includes 4,467.6 miles. The total mileage of Federal-aid roads completed up to the close of the fiscal year 1925 was 946.9 miles, of which 152 miles built prior to the designation of the Federal-aid system are not included in the system. Of the completed mileage 265.5 miles was added during the fiscal year 1925. At the close of the year there were under construction 178 miles, and approved but not yet placed under construction 36 miles. The greater part of the completed mileage was surfaced with Portland cement concrete and gravel. Of the former type there are 359.6 miles and of the latter 209.8 miles. In addition there are 252.5 miles of earth roads graded and drained, 18.1 miles of waterbound macadam, 55.5 miles of bituminous macadam, 49.6 miles of bituminous concrete, and bridges with an aggregate length of 1.8 miles.

The total cost of the roads completed during the year was \$7,378,440, of which the Federal share was \$3,945,529. The actual disbursement of Federal funds to the State during the year was \$3,346,816.

Colorado.—The Federal-aid highway system in Colorado includes 3,332 miles. Of this mileage there had been completed with Federal aid up to the close of the last fiscal year 712.5 miles and other Federal-aid roads completed but not included in the system have a length of 8.9 miles. Of the completed mileage 134.2 miles was added during the fiscal year 1925. At the close of the year there were 97 miles under construction and 53 miles approved but not yet placed under construction. The greater part of the completed mileage is surfaced with gravel and Portland cement concrete. Of these types there are 296.6 miles of the former and 164 miles of the latter. In addition, the completed roads include 171.4 miles of graded and drained earth roads, 75.8 miles of sand-clay, and 1 mile of bituminous concrete, and the bridges completed have an aggregate length of 3.7 miles.

The total cost of the roads completed during the fiscal year was \$3,678,153, of which the Federal Government paid \$1,960,296. The actual disbursement of Federal funds to the State during the year was \$1,678,505.

Connecticut.—The section of the Federal-aid highway system in this State includes 835.43 miles. Of this mileage

118.4 miles had been completed up to the close of the fiscal year with Federal aid and no Federal-aid roads had been built which were not included in the system. The roads completed during the last fiscal year amount to 36.6 miles and there were under construction at the close of the year 14 miles additional, besides which there were 6.2 miles approved but not yet under construction. The completed mileage includes 82.6 miles of Portland cement concrete, 27 miles of bituminous macadam and 8.8 miles of waterbound macadam.

The total cost of the roads completed during the fiscal year was \$2,170,514, of which the Federal Government paid \$703,795. The actual disbursement of Federal funds to the State during the year was \$903,810.

Delaware.—The Federal-aid highway system of Delaware includes 335.43 miles. This is one of the States in which the original 7 per cent system has been completed and additions have been authorized. A considerable part of the system has been built by the State without Federal aid, but up to the close of the fiscal year there had been completed with Federal participation 115.7 miles, all of which is included in the Federal-aid system. Of this completed mileage 31.4 miles was built during the last year and at the close of the year there were under construction an additional 4 miles, and approved but not yet under construction 19 miles more. With the exception of 6.2 miles surfaced with brick and 0.2 mile which consists of a bridge, all the Federal-aid roads completed in this State have been surfaced with Portland cement concrete, there being 109.3 miles of this type.

The total cost of the roads completed during the fiscal year was \$1,169,291, of which the Federal Government paid \$465,084. The actual disbursement of Federal funds to the State during the year was \$385,737.

Florida.—The section of the Federal-aid highway system in this State includes 1,901 miles. All but 22 miles of the 212.8 miles completed are included in the system, the excluded mileage having been constructed prior to the designation of the system. Of the completed mileage 100.2 miles was added during the fiscal year 1925 and in addition there were under construction at the close of the year 135 miles, and approved but not yet under construction a bridge with a length of 0.1 mile. The completed roads consist of 20 miles of graded and drained earth, 34.1 miles of sand-clay, 64.8

miles of bituminous macadam, 12.8 miles of bituminous concrete, 70.7 miles of Portland cement concrete, 10.1 miles of brick, in addition to which there are bridges with a total length of 0.3 mile.

The total cost of the roads completed during the fiscal year was \$3,328,705, of which the Federal share was \$1,627,053. The actual disbursement of Federal funds to the State during the year was \$1,201,584.

Georgia.—The Georgia section of the Federal-aid highway system includes 5,557.9 miles. The Federal-aid roads completed up to the close of the fiscal year 1925 have a total length of 1,652.8 miles, but 105 miles included in this total were built prior to the designation of the Federal-aid system and are not included in it. Three hundred and twenty-six miles were completed during the last fiscal year and at the close of the year 566 miles were under construction and 35 miles were approved for construction. The greater part of the completed mileage is surfaced with sand-clay, there being 1,055.5 miles of this type. Of other roads completed there are 73.6 miles of graded and drained earth, 286.2 miles of gravel, 27.4 miles of waterbound macadam, 69.1 miles of bituminous macadam, 11.6 miles of bituminous concrete, 109.9 miles of Portland cement concrete and 0.5 mile of brick. Bridge construction in this State has been carried on to a greater extent than in any other with the exception of Texas, the completed bridges having a total length of 19 miles.

The total cost of the roads completed during the fiscal year was \$4,306,914, of which \$2,118,847 was paid by the Federal Government. The actual disbursement of Federal funds to the State during the year was \$2,494,796.

Idaho.—Idaho's section of the Federal-aid highway system includes 2,768.6 miles. The Federal-aid roads completed up to the close of the year have a total length of 639.9 miles, and only 24 miles of this total are not on the Federal-aid system. The mileage completed during the year was 113.1 miles. At the close of the year there were under construction 115 miles and approved for construction 37 miles. In this State, where traffic is relatively light, the greater part of the completed mileage consists of roads surfaced with gravel, there being 402.8 miles of this type. In addition, there are 158.6 miles of graded and drained earth roads, 18.8 miles of sand-clay,

4.3 miles of waterbound macadam, 33 miles of bituminous concrete, and 21.3 miles of Portland cement concrete. Bridges completed up to the close of the fiscal year have a total length of 1.1 miles.

The total cost of the roads completed during the fiscal year was \$1,287,097, of which the Federal Government paid \$771,199. The actual disbursement of Federal funds to the State during the year, however, was \$885,245.

Illinois.—The Federal-aid highway system of Illinois includes 5,002.2 miles. The sections of the system completed up to the close of the fiscal year with Federal aid have a total length of 1,284.7 miles, and no Federal-aid roads have been built which are not on the system. Of this completed mileage 370.5 miles was added during the fiscal year 1925. At the close of the year there were 222 miles under construction and 17 miles approved for construction. Nearly the entire completed mileage is surfaced with Portland cement concrete, there being 1,114.8 miles of this type. In addition there are 138.1 miles of graded and drained earth roads, 0.4 mile of gravel, 3.3 miles of bituminous macadam, 8.1 miles of bituminous concrete, and 18.6 miles surfaced with brick. Bridges completed in the State have a total length of 1.4 miles.

The total cost of the roads completed during the fiscal year was \$10,931,911, of which the Federal Government paid \$5,285,725. The actual disbursement of Federal funds to the State during the year was \$3,621,054.

Indiana.—The Indiana section of the Federal-aid highway system includes 4,679 miles. With the exception of 2.5 miles the Federal-aid roads completed up to the close of the fiscal year 1925, of which there are 530 miles, are included in the system. The roads completed during the fiscal year have a total length of 266.8 miles and at the close of the year there were 325 miles under construction and 23 miles approved but not yet under construction. In this State, as in the neighboring State of Illinois, the greater part of the completed mileage is surfaced with Portland cement concrete. There are 445 miles of this type, in addition to 19.8 miles of graded and drained earth, 27.1 miles of gravel, 7.5 miles of waterbound macadam, 17 miles of bituminous macadam, and 12 miles of bituminous concrete. Bridges completed up to the close of the year have a total length of 1.6 miles.

The total cost of the roads completed during the fiscal year was \$8,312,508, of which the Federal Government paid \$4,027,473. The actual disbursement of Federal funds to the State during the year was \$4,184,160.

Iowa.—The Iowa section of the Federal-aid highway system includes 7,231 miles. All Federal-aid roads completed up to the close of the fiscal year, of which there are 2,038.2 miles, are included in the system. The mileage completed during the fiscal year was 349.6 miles. At the close of the year there were 393 miles additional under construction, and 90 miles approved for construction. The greater part of the mileage completed in this State consists of graded and drained earth roads, there being 1,251.6 miles of this type which have been built as the first stage of an improvement which, as funds become available, will be completed by surfacing. In addition to the graded roads, there are 389.4 miles surfaced with gravel, 375 miles paved with Portland cement concrete and 22 miles with brick. Bridges completed up to the close of the fiscal year have a total length of 0.2 mile.

The total cost of the roads completed during the year was \$4,209,963, of which the Federal Government paid \$1,939,531. The actual disbursement of Federal funds to the State during the year was \$1,839,907.

Kansas.—The Kansas section of the Federal-aid highway system includes 7,516 miles. All Federal-aid roads completed up to the close of the year, of which there were 994.5 miles, are included in the system. Of this completed mileage 337 miles was added during the fiscal year 1925. At the close of the year there were 437 miles under construction and 13 miles approved for construction. Of the mileage completed up to the close of the year there were 181.6 miles of graded and drained earth roads, 88 miles of sand-clay, 125.2 miles of gravel, 4.5 miles of waterbound macadam, 56.5 miles of bituminous macadam, 431.4 miles of Portland cement concrete, 105.6 miles of brick, and the bridges completed have a total length of 1.7 miles.

The total cost of the roads completed during the fiscal year was \$8,265,215, of which the Federal share was \$3,593,498. The actual disbursement of Federal funds to the State during the year was \$2,917,961.

Kentucky.—Kentucky's section of the Federal-aid highway system includes 3,639.95 miles, of which, up to the

close of the fiscal year 1925, 598.6 miles had been completed with Federal aid. Of this completed mileage 145.7 miles was added during the fiscal year 1925. At the close of the year there were 285 miles under construction and 40 miles approved for construction. The roads completed include 335.8 miles of graded and drained earth, 69.2 miles of gravel, 41.1 miles of waterbound macadam, 105.8 miles of bituminous macadam, 42 miles of Portland cement concrete, and 3.9 miles of brick. Bridges completed up to the close of the fiscal year have a total length of 0.8 mile.

The total cost of the roads completed during the year was \$4,159,571, of which the Federal share is \$1,662,848. The actual disbursement of Federal funds to the State during the year was \$1,849,055.

Louisiana.—There are 2,771 miles in Louisiana's section of the Federal-aid highway system. The Federal-aid roads completed up to the close of the fiscal year 1925 have a total length of 1,025.5 miles, of which all but 103 miles completed prior to the designation of the Federal-aid system, are included in the system. Of the completed mileage 324.4 miles was added during the last fiscal year. At the close of the year there were 72 miles under construction and 3 miles approved for construction. The greater part of the mileage completed is surfaced with gravel, there being 996.2 miles of this type. In addition, the completed mileage includes 7.4 miles of graded and drained earth, 3.2 miles of waterbound macadam, 9.5 miles of bituminous macadam, and 7.6 miles of bituminous concrete, and the bridges completed have a total length of 1.6 miles.

The total cost of the roads completed during the fiscal year was \$4,538,345, of which the Federal share was \$2,195,490. The actual disbursement of Federal funds to the State during the year was \$1,243,790.

Maine.—The section of the Federal-aid highway system in Maine includes 1,393.46 miles. All Federal-aid roads completed up to the close of the last fiscal year, of which there were 288 miles, are included in the system. Fifty-one miles were added to the system during the last fiscal year and at the close of the year there were 35 miles under construction. The greater part of the mileage completed was surfaced with gravel and bituminous macadam, there being 120.5 miles of the former type and 128 miles of the latter. In addition to these roads

there were only 39.3 miles surfaced with Portland cement concrete. The bridges completed up to the close of the year have a total length of 0.2 mile.

The total cost of the roads completed during the fiscal year was \$1,330,369, of which the Federal share was \$641,229. The actual disbursement of Federal funds to the State during the year was \$510,283.

Maryland.—The Maryland section of the Federal-aid highway system includes 1,417.48 miles. The Federal-aid roads completed in the State up to the close of the fiscal year have a total length of 320 miles, of which, however, 63.4 miles completed prior to the designation of the Federal-aid highway system is not included in the system. Of the completed Federal-aid mileage 67.3 miles was added during the fiscal year 1925. At the close of the year there were under construction 31 miles and approved for construction 85 miles. The greater part of the mileage completed up to the close of the fiscal year was paved with Portland cement concrete, there being 230.7 miles of this type, besides which there are 3.8 miles of graded and drained earth roads, 31.5 miles surfaced with gravel, 0.1 mile of waterbound macadam, 41.6 miles of bituminous macadam, and 12.3 miles of bituminous concrete.

The total cost of the roads completed during the fiscal year was \$1,937,750, of which the Federal share was \$878,368. The actual disbursement of Federal funds to the State during the year was \$621,915.

Massachusetts.—The Federal-aid highway system in Massachusetts includes 1,308 miles. All but 23 miles of the 328.9 miles of Federal-aid roads completed up to the close of the last fiscal year are included in the system. During the last fiscal year the mileage completed was 74.5 miles. In addition, there were under construction at the close of the year 56 miles and approved for construction 11 miles. The completed roads consist of 184.4 miles of bituminous macadam, 109.7 miles of Portland cement concrete, 30.2 miles of bituminous concrete, and 3.3 miles of waterbound macadam, and the bridges completed have a total length of 1.3 miles.

The total cost of the roads completed during the fiscal year was \$4,280,919, of which the Federal share was \$1,474,831. The actual disbursement of Federal funds to the State during the year was \$1,369,630.

Michigan.—The Michigan section of the Federal-aid highway system includes 4,768 miles. In this State there had been completed up to the close of the last fiscal year 861.7 miles of Federal-aid roads, all but 19 miles of which is included in the Federal-aid system. Of the completed mileage 287.8 miles was added during the last fiscal year. At the close of the year there were 226 miles under construction. The greater part of the completed mileage is surfaced with Portland cement concrete and gravel, there being of the former type 415.8 miles and of the latter 319.8 miles. In addition, there are 25.7 miles of graded and drained earth roads, 18.9 miles of waterbound macadam, 5 miles of bituminous macadam, 76.1 miles of bituminous concrete, and 0.4 mile of brick.

The total cost of the roads completed during the fiscal year was \$7,104,249, of which the Federal share was \$3,321,499. The actual disbursement of Federal funds to the State during the year was \$3,609,501.

Minnesota.—The Federal-aid highway system in Minnesota includes 6,849.6 miles. The Federal-aid roads completed up to the close of the fiscal year have a total length of 2,721.2 miles, all of which, with the exception of 192 miles completed prior to the designation of the system, are included in the Federal-aid highway system. Of the mileage completed, 411 miles was added during the last fiscal year and at the close of the year there were 684 miles under construction and 146 miles approved for construction. The mileage completed in this State is greater than in any State with the exception of Texas, and the greater part of it is surfaced with gravel, there being 1,970.7 miles of this type. There are also 466.1 miles of graded and drained earth roads, 22.1 miles of bituminous concrete and 261.9 miles of Portland cement concrete. Bridges completed up to the close of the fiscal year have a total length of 0.4 mile.

The total cost of the roads completed during the fiscal year was \$6,424,894, of which the Federal share was \$2,848,805. The actual disbursement for Federal funds to the State during the year was \$3,233,220.

Mississippi.—The section of the Federal-aid highway system in Mississippi includes 3,329 miles. Of the 872.5 miles of Federal-aid roads completed up to the close of the fiscal year 108 miles are not included in the sys-

tem. These roads were projected and built prior to the designation of the system in 1921. Of the total completed mileage 217.5 miles was added during the last year. At the close of the year 422 miles additional were under construction and 42 miles were approved for construction. The greater part of the mileage completed was surfaced with gravel, there being 569.1 miles of this type. The balance of the completed mileage consists of 181.7 miles of graded and drained earth roads, 17.6 miles of sand-clay, 11.1 miles of waterbound macadam, 1 mile of bituminous macadam, 9.2 miles of bituminous concrete, 73.4 miles of Portland cement concrete and 9.2 miles paved with brick. Bridges completed in the State up to the close of the fiscal year have a total length of 6.2 mile.

The total cost of the roads completed during the fiscal year was \$3,487,896, of which the Federal share was \$1,701,759. The actual disbursement of Federal funds to the State during the year was \$2,171,302.

Missouri.—The Federal-aid highway system in Missouri includes 7,530 miles, and, with the exception of 32 miles completed prior to the designation of the system, the entire mileage of Federal-aid roads completed up to the close of the fiscal year, amounting to 1,349.6 miles, is included in the system. Of the completed mileage 443.5 miles was added during the last fiscal year. At the close of the year there were under construction 638 miles and approved for construction 18 miles. The completed roads are mainly of three types, the greatest mileage being surfaced with gravel, of which there are 708 miles. In addition there are 300.1 miles of graded and drained earth roads, 252.3 miles of Portland cement concrete, 13.4 miles of waterbound macadam, 48.9 miles of bituminous macadam, 17.7 miles of bituminous concrete, and 6.2 miles of brick. The bridges completed with Federal aid have a total length of 3 miles.

The total cost of the roads completed during the fiscal year was \$9,808,732, of which the Federal share was \$4,780,497. The actual disbursement of Federal funds to the State during the year was \$4,208,311.

Montana.—The Montana section of the Federal-aid highway system includes 4,366 miles. The Federal-aid roads completed up to the close of the fiscal year have a total length of 937.7 miles, but 193 miles constructed prior to the designation of the system are

not included in it. Of the completed mileage 132 miles was built during the last fiscal year and at the close of the year there were under construction 167 miles and approved for construction 117 miles. The larger part of the completed mileage is surfaced with gravel, there being 664.9 miles of this type. There are also 215.8 miles of graded and drained earth roads, 16 miles of waterbound macadam, 6.9 miles of bituminous macadam, 0.9 mile of bituminous concrete, and 31.3 miles of Portland cement concrete. The bridges completed have a total length of 1.9 miles.

The total cost of the roads completed during the fiscal year was \$1,462,935, of which the Federal share was \$1,024,548. The actual disbursement of Federal funds to the State during the year was \$1,142,609.

Nebraska.—The Nebraska section of the Federal-aid highway system includes 5,489 miles. All but 19.3 miles of the 1,874.7 miles of Federal-aid roads completed up to the close of the fiscal year are included in the system. Of the total mileage completed 155.8 miles was completed during the last fiscal year and at the close of the year there were 545 miles under construction and 43 miles approved for construction. The completed mileage includes 1,454.1 miles of graded and drained earth roads, 141.5 miles of sand-clay, 217.1 miles of gravel, 9.4 miles of bituminous concrete, 37.4 miles of Portland cement concrete, and 14.3 miles paved with brick. The bridges completed up to the close of the year have a total length of 0.9 mile.

The total cost of the roads completed during the fiscal year was \$2,656,656, of which the Federal share was \$1,276,615. The actual disbursement of Federal funds to the State during the year was \$1,535,989.

Nevada.—The Nevada section of the Federal-aid highway system includes 1,434 miles. The roads completed with Federal aid up to the close of the fiscal year have a total length of 427.8 miles, and with the exception of 25 miles constructed prior to the designation of the system this entire mileage is included in it. The mileage completed during the last fiscal year amounts to 145.3 miles, and at the close of the year there were under construction 379 miles and approved for construction 17 miles. The completed mileage includes 265.4 miles of gravel, 73.5 miles of graded and drained earth roads, 24.9 miles of sand-clay, 20.6 miles of bituminous mac-

adam, 1.6 miles of bituminous concrete, and 40.4 miles of Portland cement concrete. Bridges built up to the close of the fiscal year have a total length of 1.4 miles.

The total cost of the roads completed during the fiscal year was \$2,087,851, of which the Federal share was \$1,700,958. The actual disbursement of Federal funds to the State during the year was \$1,900,041.

New Hampshire.—The Federal-aid highway system in New Hampshire includes 977.39 miles. The roads completed with Federal aid up to the close of the fiscal year have a total length of 215 miles, of which all but 17 miles is included in the Federal-aid system. The mileage completed during the last fiscal year amounts to 38.8 miles. At the close of the year there were under construction 22 miles additional and approved for construction 6 miles. The completed mileage includes 94.8 miles of gravel roads, 32 miles of waterbound macadam, 52.8 miles of bituminous macadam, 30 miles of bituminous concrete, and 4.3 miles of Portland cement concrete. The completed bridges have a total length of 1.1 miles.

The total cost of the roads completed during the fiscal year was \$1,147,421, of which the Federal share was \$531,483. The actual disbursement of Federal funds to the State during the year was \$553,913.

New Jersey.—New Jersey's section of the Federal-aid highway system includes 1,198.3 miles. Of this mileage 229.6 miles have been completed with Federal aid, of which 70.4 miles were completed during the last fiscal year. At the close of the year 53 miles were under construction and 19 miles were approved for construction. The greater part of the completed mileage of this State is paved with Portland cement concrete, there being 211.9 miles of this type. In addition there are 1.6 miles of graded and drained earth roads, 3.4 miles of gravel, and 12.6 miles of bituminous concrete, and one bridge with a total length of 0.1 mile.

The total cost of the roads completed during the fiscal year was \$4,802,169, of which the Federal share was \$1,158,534. The actual disbursement of Federal funds to the State during the year was \$1,889,720.

New Mexico.—The New Mexico section of the Federal-aid highway sys-

tem includes 3,250 miles. Federal-aid roads completed up to the close of the fiscal year have a total length of 1,353 miles, but 252 miles completed prior to the designation of the system are not included. During the last fiscal year 473.4 miles have been completed and at the close of the year there were under construction 123 miles and approved for construction 12 miles. The completed roads are largely of the gravel type, there being of this character 1,065.3 miles. In addition, there are 221.8 miles of graded and drained earth roads, 5.1 miles of sand-clay, 0.7 mile of bituminous concrete, and 59.3 miles of Portland cement concrete. The bridges completed up to the close of the fiscal year have a total length of 0.8 mile.

The total cost of the roads completed during the fiscal year was \$5,008,465, of which the Federal share was \$3,340,291. The actual disbursement of Federal funds to the State during the year was \$2,910,090.

New York.—The section of the Federal-aid highway system in New York has a total length of 5,012 miles. Federal-aid roads completed up to the close of the fiscal year amount to 972 miles, but 442 miles completed prior to the designation of the system are not included in it. The mileage completed during the last fiscal year was 344.4 miles, and there were under construction at the close of the year 487 miles and approved for construction 118 miles. The entire completed mileage is surfaced with one or the other of four high types of surfacing. A total of 697.1 miles is paved with Portland cement concrete, 267.9 miles are surfaced with bituminous macadam, 4.8 miles with bituminous concrete, and 0.7 mile with brick. The total length of the bridges completed up to the close of the year was 1.5 miles.

The total cost of the roads completed during the fiscal year was \$13,779,859, of which the Federal share was \$5,548,190. The actual disbursement of Federal funds to the State during the year was \$4,813,178.

North Carolina.—The Federal-aid highway system in North Carolina includes 3,790.3 miles. Up to the close of the fiscal year the mileage of Federal-aid roads completed was 1,178.5 miles, of which all but 145 miles was included in the Federal-aid highway system, the excluded mileage having been constructed prior to the designation of the system. Of the completed

mileage 173.4 miles was added during the fiscal year. At the close of the year there were 158 miles under construction and 43 miles approved for construction. The completed mileage consisted of 76.1 miles of graded and drained earth roads, 590.4 miles of sand-clay, 85.8 miles of gravel, 12.8 miles of waterbound macadam, 38 miles of bituminous macadam, 141.5 miles of bituminous concrete and 232.3 miles of Portland cement concrete. The bridges completed up to the close of the year have a total length of 1.6 miles.

The total cost of the roads completed during the fiscal year was \$6,475,468, of which the Federal share was \$2,440,273. The actual disbursement of Federal funds to the State during the year was \$2,087,591.

North Dakota.—The section of the Federal-aid highway system in North Dakota includes 6,154 miles. All but 84 miles of the 2,015.3 miles of Federal-aid roads completed up to the close of the fiscal year were included in the system, the excluded mileage having been constructed prior to the designation of the system. Of the completed mileage 381.1 miles was added during the fiscal year 1925 and at the close of the year there were under construction 369 miles and approved for construction 95 miles. The greater part of the completed mileage is of two types, there being 1,648 miles of graded and drained earth roads and 355 miles of gravel. In addition there are 6.5 miles of sand-clay roads, 1.2 miles of bituminous concrete, and 3 miles of Portland cement concrete. The bridges completed up to the close of the year have a total length of 1.6 miles.

The total cost of the roads completed during the fiscal year was \$2,554,397, of which the Federal share was \$1,230,646. The actual disbursement of Federal funds to the State during the year was \$934,328.

Ohio.—Ohio's section of the Federal-aid highway system includes 5,798.5 miles. The Federal-aid roads completed up to the close of the fiscal year have a total length of 1,225.6 miles, of which 82 miles are not included in the Federal-aid highway system, having been completed prior to the designation of the system. Of the completed mileage 240.8 miles was added during the fiscal year 1925 and at the close of the year 250 miles were under construction and 100 miles were

approved for construction. The completed mileage consists of 393.4 miles of Portland cement concrete roads 380.9 miles paved with brick, 88.1 miles surfaced with bituminous concrete, 246.3 miles of bituminous macadam, 82.6 miles of waterbound macadam, and 34.2 miles of graded and drained earth roads. The bridges completed have a length of only 0.1 mile.

The total cost of the roads completed during the fiscal year was \$8,899,524, of which the Federal share was \$3,548,113. The actual disbursement of Federal funds to the State during the year was \$2,652,957.

Oklahoma.—The section of the Federal-aid highway system in Oklahoma includes 5,573 miles. Of the 910.2 miles of Federal-aid roads completed up to the close of the fiscal year all but 8.6 miles are included in the system, the latter mileage having been constructed prior to the designation of the system. Of the completed mileage 412.9 miles, or nearly one-half, was completed during the fiscal year and at the close of the year there were 254 miles under construction and 47 miles approved for construction. The completed roads consist of 40.4 miles of graded and drained earth roads, 2.3 miles of sand-clay, 526.7 miles of gravel, 6.3 miles of waterbound macadam, 0.6 mile of bituminous macadam, 64.5 miles of bituminous concrete, 257.5 miles of Portland cement concrete, and 4 miles of brick. The bridges have a total length of 7.9 miles.

The total cost of the roads completed during the fiscal year was \$9,420,729, of which the Federal share was \$4,532,987. The actual disbursement of Federal funds to the State during the year was \$2,852,978.

Oregon.—The Oregon section of the Federal-aid highway system includes 2,814 miles. The Federal-aid roads completed up to the close of the fiscal year have a total length of 829.2 miles, all of which is included in the Federal-aid system. Of the completed mileage 153 miles were completed during the fiscal year and at the close of the year there were 102 miles under construction and 39 miles approved for construction. The completed mileage consists of 553.7 miles of gravel, 110.2 miles of graded and drained earth roads, 25.6 miles of waterbound macadam, 52.9 miles of bituminous concrete, and 85.7 miles of Portland

cement concrete. The bridges completed up to the close of the year have a total length of 1.1 miles.

The total cost of the roads completed during the fiscal year was \$2,618,037, of which the Federal share was \$1,510,345. The actual disbursement of Federal funds to the State during the year was \$1,091,482.

Pennsylvania.—Pennsylvania's section of the Federal-aid highway system includes 3,670.55 miles. All but 2.5 miles of the Federal-aid roads completed up to the close of the fiscal year 1925, amounting to 987.6 miles, are included in the system. Of the completed mileage 156.6 miles was added during the fiscal year and at the close of the year 392 miles were under construction and 155 miles approved for construction. The entire completed mileage in this State is surfaced with one of the higher types of pavement. There are 852.7 miles of Portland cement concrete, 101.9 miles of bituminous concrete, 25.2 miles of brick, and 7.8 miles of bituminous macadam. No bridges have been built in this State with Federal aid.

The total cost of the roads completed during the fiscal year was \$8,605,472, of which the Federal share was \$2,436,028. The actual disbursement of Federal funds to the State during the year was \$3,701,190.

Rhode Island.—The section of the Federal-aid highway system in Rhode Island includes 234.13 miles, which is in excess of 7 per cent of the total highway mileage of the State, as a result of extensions authorized on the completion of the original 7 per cent system. Up to the close of the fiscal year there had been completed in the State with Federal aid 70.8 miles, all of which was included in the Federal-aid system, and of this mileage 21.7 miles had been added during the fiscal year. At the close of the year there were under construction 20 miles and approved for construction 9 miles. The entire completed mileage was surfaced with one of the higher types of pavement, there being 37 miles of bituminous concrete, 23.3 miles of Portland cement concrete, and 10.5 miles of bituminous macadam. No bridges have been constructed with Federal aid.

The total cost of the roads completed during the fiscal year was \$1,202,132, of which the Federal share was \$440,391. The actual disburse-

ment of Federal funds to the State during the year was \$359,282.

South Carolina.—The section of the Federal-aid highway system in South Carolina includes 3,150 miles. At the close of the fiscal year 1925, 1,311.1 miles of Federal-aid roads had been completed, of which 103.5 miles completed prior to the designation of the Federal-aid system are not included in it. Of the completed mileage 275.5 miles had been added during the fiscal year 1925, and at the close of the year there were under construction 298 miles and approved for construction 35 miles. The completed mileage includes 10.8 miles of graded and drained earth roads, 1,105.4 miles of sand-clay roads, 100.9 miles of gravel, 3 miles of bituminous macadam, 38 miles of bituminous concrete, 49 miles of Portland cement concrete, and 0.2 mile of brick. The bridges completed in the State have a total length of 3.8 miles.

The total cost of the roads completed during the fiscal year was \$3,158,766, of which the Federal share was \$1,285,212. The actual disbursement of Federal funds to the State during the year was \$1,220,841.

South Dakota.—South Dakota's section of the Federal-aid highway system includes 5,666 miles. The mileage of Federal-aid roads completed up to the close of the fiscal year 1925 was 1,579.9 miles, of which all but 20.9 miles was included in the Federal-aid system. Of the completed mileage 483.3 miles, or almost 30 per cent, was added during the last fiscal year. At the close of the year there were under construction 879 miles and approved for construction 55 miles. The greater part of the completed mileage was surfaced with gravel, there being 1,293.8 miles of this type. In addition there were 281.7 miles of graded and drained earth roads, 2.5 miles of sand-clay and 0.8 mile of Portland cement concrete. The bridges completed up to the close of the fiscal year have a total length of 1.1 miles.

The total cost of the roads completed during the fiscal year was \$3,802,882, of which the Federal share was \$1,877,063. The actual disbursement of Federal funds to the State during the year was \$1,856,560.

Tennessee.—The section of the Federal-aid highway system in Tennessee includes 3,180.2 miles. The Federal-aid roads completed up to the close of

the fiscal year have a total length of 596.5 miles, of which all but 37 miles completed prior to the designation of the Federal-aid highway system are included in the system. Of the completed mileage 304.4 miles, or more than 50 per cent, was added during the last fiscal year. At the close of the year there were under construction 324 miles. The completed mileage includes 363.4 miles of bituminous macadam, 94.4 miles of gravel, 50.8 miles of Portland cement concrete, 52.3 miles of waterbound macadam, 21.9 miles of bituminous concrete and 13.1 miles of graded and drained earth roads. The bridges completed have a combined length of 0.6 mile.

The total cost of the roads completed during the fiscal year was \$9,355,548, of which the Federal share was \$4,604,189. The actual disbursement of Federal funds to the State during the year was \$3,079,450.

Texas.—Texas, the largest State in the Union, has the largest section of the Federal-aid highway system, including 10,932 miles. Of the Federal-aid roads completed, amounting to 4,332.3 miles, all but 327 miles, completed prior to the designation of the Federal-aid highway system, are included in it. Of the completed mileage 1,170.8 miles was added during the last fiscal year and at the close of the year there were under construction 1,084 miles and approved for construction 185 miles. The greater part of the completed mileage was surfaced with gravel, there being 2,756.2 miles of this type. In addition, the completed mileage includes 303.8 miles of graded and drained earth roads, 61.2 miles of sand-clay, 448 miles of waterbound macadam, 309.3 miles of bituminous macadam, 77.7 miles of bituminous concrete, 329.5 miles of Portland cement concrete, and 24.8 miles of brick. Up to the close of the fiscal year the bridges had a combined length of 21.8 miles.

The total cost of the roads completed during the fiscal year was \$19,488,335, of which the Federal share was \$7,870,617. The actual disbursement of Federal funds to the State during the year was \$5,136,128.

Utah.—The Federal-aid highway system of Utah includes 1,588 miles. Of the 487.4 miles of Federal-aid roads completed up to the close of the fiscal year 167 miles completed prior to the designation of the system are not included in it. During the fiscal year 169.9 miles were completed and at the

close of the year 162 miles were under construction and 25 miles were approved for construction. The completed mileage consists of 242.3 miles of gravel, 101.1 miles of graded and drained earth roads, 37.6 miles of sand-clay, 9.3 miles of waterbound macadam, 7.8 miles of bituminous concrete, and 88 miles of Portland cement concrete. The bridges completed up to the close of the fiscal year have a total length of 1.3 miles.

The total cost of the roads completed during the fiscal year was \$3,167,835, of which the Federal share was \$2,102,039. The actual disbursement of Federal funds to the State during the year was \$1,554,844.

Vermont.—Vermont's section of the Federal-aid highway system includes 1,043 miles. With the exception of 1 mile constructed prior to the designation of the system, all Federal-aid roads completed up to the close of the fiscal year 1925, amounting to 108 miles, were included in the system. Of the completed mileage 33.6 miles were added during the fiscal year 1925, and at the close of the year 26 miles were under construction and 9 miles were approved for construction. The completed mileage includes 72.8 miles of gravel roads, 3.4 miles of waterbound macadam, 19.7 miles of bituminous macadam, and 10.8 miles of Portland cement concrete. The bridges completed have a combined length of 1.3 miles.

The total cost of roads completed during the fiscal year was \$1,112,697, of which the Federal share was \$519,944. The actual disbursement of Federal funds to the State during the year was \$563,080.

Virginia.—The Federal-aid highway system in Virginia includes 3,075.5 miles. The Federal-aid roads completed up to the close of the last fiscal year have a total length of 859.6 miles, of which all but 43 miles are included in the Federal-aid system. Of the completed mileage 238.8 miles were completed during the last fiscal year and at the close of the year 165 miles were under construction and 59 miles were approved for construction. The completed roads include 241.6 miles of Portland cement concrete, 186.2 miles of bituminous macadam, 199.7 miles of sand-clay, 108.5 miles of waterbound macadam, 84.7 miles of gravel, 27 miles of graded and drained earth roads, and 10.6 miles of bituminous concrete. The bridges completed have a total length of 1.3 miles.

The total cost of the roads completed during the fiscal year was \$7,017,132, of which the Federal share was \$3,279,419. The actual disbursement of Federal funds to the State during the year was \$1,878,842.

Washington.—The Washington section of the Federal-aid highway includes 2,907.7 miles. All but 12 miles of the 551.9 miles of Federal-aid roads completed up to the close of the fiscal year 1925 were included in the Federal-aid system. Of the total mileage completed 82.7 miles were added during the fiscal year, and at the close of the year 102 miles were under construction and 22 miles were approved for construction. The completed mileage includes 200.9 miles of Portland cement concrete, 296.8 miles of gravel, and 52.4 miles of graded and drained earth roads. The bridges completed up to the close of the year have a combined length of 1.8 miles.

The total cost of the roads completed during the fiscal year was \$3,295,914, of which the Federal share was \$1,430,498. The actual disbursement of Federal funds to the State during the year was \$1,101,796.

West Virginia.—The West Virginia section of the Federal-aid highway system includes 1,918.5 miles. Of the 335.9 miles of Federal-aid roads completed up to the close of the fiscal year 74 miles completed prior to the designation of the Federal-aid highway system are not included in it. The mileage completed during the last fiscal year was 60.1 miles and at the close of the year there were 140 miles under construction and 50 miles approved for construction. The completed mileage includes 138.5 miles of graded and drained earth roads, 1.7 miles of sand-clay, 18.3 miles of gravel, 4.9 miles of waterbound macadam, 69.7 miles of bituminous macadam, 16.3 miles of bituminous concrete, 74.9 miles of Portland cement concrete, and 11.4 miles paved with brick. The bridges completed up to the close of the fiscal year have a length of 0.2 mile.

The total cost of the roads completed during the fiscal year was \$1,354,742, of which the Federal share was \$658,321. The actual disbursement of Federal funds to the State during the year was \$630,039.

Wisconsin.—The section of the Federal-aid highway system in Wisconsin

includes 5,493.36 miles. Up to the close of the year 1,484.6 miles of Federal-aid roads had been completed, but 267 miles completed prior to the designation of the Federal-aid system are not included in it. Of the completed mileage 127.8 miles were completed during the last fiscal year, and at the close of the year 147 miles were under construction and 90 miles approved for construction. The completed mileage includes 731.9 miles of gravel roads, 366.3 miles of Portland cement concrete, 233.6 miles of graded and drained earth roads, 140.5 miles of sand-clay, 9.6 miles of bituminous macadam, and 2.7 miles of waterbound macadam. The bridges completed up to the close of the year have a length of 0.1 mile.

The total cost of the roads completed during the fiscal year was \$3,586,726, of which the Federal share was \$1,742,090. The actual disbursement of Federal funds to the State during the year was \$1,325,077.

Wyoming.—Wyoming's section of the Federal-aid highway system includes 3,071.7 miles. The Federal-aid roads completed up to the close of the year have a total length of 1,037.8 miles, of which all but 59 miles completed prior to the designation of the Federal-aid highway system are not included in it. Of the completed mileage 325.5 miles, or approximately 30 per cent of the total, was added during the last fiscal year. At the close of the year the roads under construction had a total length of 201 miles and 54 miles were approved for construction. The completed mileage includes 462.3 miles of sand-clay, 310.8 miles of graded and drained earth roads, 246.2 miles of gravel, 1.2 miles of bituminous concrete, and 14.3 miles of Portland cement concrete. The bridges completed have a combined length of 3 miles.

The total cost of the roads completed during the fiscal year was \$3,418,864, of which the Federal share was \$2,100,081. The actual disbursement of Federal funds to the State during the year was \$1,728,033.

Complete statistics of the Federal-aid roads completed during the fiscal year and during the entire period under the Federal-aid plan with reference to mileage and types completed and the total costs and Federal-aid allotments are given in Tables 10 to 15, inclusive.

TABLE 10.—*Total cost, Federal aid and mileage of Federal-aid roads completed during the fiscal year 1925—by States*

States	Total cost ¹	Federal aid ¹	Miles ²
Alabama.....	\$8,946,220.40	\$4,405,980.35	482.2
Arizona.....	1,685,978.33	999,603.78	132.8
Arkansas.....	4,713,282.21	1,766,874.26	188.0
California.....	7,378,440.12	3,945,529.15	265.5
Colorado.....	3,678,153.52	1,960,296.36	134.2
Connecticut.....	2,170,514.26	703,795.06	36.6
Delaware.....	1,169,291.33	465,084.42	31.4
Florida.....	3,328,705.13	1,627,053.47	100.2
Georgia.....	4,306,914.03	2,118,847.66	326.0
Idaho.....	1,287,097.12	771,198.81	113.1
Illinois.....	10,931,911.27	5,285,725.74	370.5
Indiana.....	8,312,508.53	4,027,473.09	266.8
Iowa.....	4,209,963.04	1,939,561.13	349.6
Kansas.....	8,265,215.10	3,593,498.16	337.0
Kentucky.....	4,159,571.09	1,662,848.80	145.7
Louisiana.....	4,538,345.13	2,195,489.99	324.1
Maine.....	1,330,368.99	641,229.37	51.0
Maryland.....	1,937,750.57	878,368.84	67.3
Massachusetts.....	4,280,919.94	1,474,830.91	74.5
Michigan.....	7,104,249.35	3,321,499.47	287.8
Minnesota.....	6,424,894.80	2,848,805.77	411.0
Mississippi.....	3,487,896.19	1,701,759.55	217.5
Missouri.....	9,808,732.34	4,780,496.96	443.5
Montana.....	1,462,935.43	1,024,548.18	132.0
Nebraska.....	2,656,656.84	1,276,615.35	155.8
Nevada.....	2,087,851.01	1,700,958.55	145.3
New Hampshire.....	1,147,421.31	531,483.77	38.8
New Jersey.....	4,802,169.82	1,158,534.72	70.4
New Mexico.....	5,008,465.60	3,340,291.69	473.4
New York.....	13,779,859.18	5,548,190.75	344.4
North Carolina.....	6,475,468.61	2,440,273.68	173.4
North Dakota.....	2,554,397.62	1,230,646.92	381.1
Ohio.....	8,899,524.96	3,548,113.26	240.8
Oklahoma.....	9,420,728.95	4,532,987.59	412.9
Oregon.....	2,618,037.60	1,510,345.67	153.0
Pennsylvania.....	8,605,471.97	2,436,027.93	156.6
Rhode Island.....	1,202,131.59	440,391.09	21.7
South Carolina.....	3,158,766.20	1,285,212.63	275.5
South Dakota.....	3,802,882.64	1,877,062.77	483.3
Tennessee.....	9,355,548.16	4,604,188.95	304.4
Texas.....	19,488,335.22	7,870,617.44	1,170.8
Utah.....	3,167,835.47	2,102,039.14	169.9
Vermont.....	1,112,697.48	519,943.89	33.6
Virginia.....	7,017,132.60	3,279,419.35	238.8
Washington.....	3,295,914.50	1,430,498.58	82.7
West Virginia.....	1,354,741.96	658,321.41	60.1
Wisconsin.....	3,586,726.64	1,742,090.95	127.8
Wyoming.....	3,418,864.42	2,100,081.88	325.5
Total.....	242,937,488.57	111,304,737.24	11,328.6

¹ Figures subject to revision on payment of a few final vouchers now outstanding.² Mileage is of original improvement only.

TABLE 11.—*Total cost, Federal aid and mileage of Federal-aid roads completed to June 30, 1925—by States*

State	Total cost ¹	Federal aid ¹	Miles ²
Alabama.....	\$16,463,873.00	\$8,051,693.34	1,153.7
Arizona.....	10,150,720.00	5,364,516.19	670.5
Arkansas.....	15,882,136.76	6,226,219.89	1,136.9
California.....	24,508,248.02	11,805,936.02	946.9
Colorado.....	13,302,271.86	6,835,486.02	712.5
Connecticut.....	5,582,139.35	2,137,293.66	118.4
Delaware.....	4,648,542.80	1,653,821.75	115.7
Florida.....	6,288,626.82	3,059,350.86	212.8
Georgia.....	22,562,665.58	10,604,649.07	1,652.8
Idaho.....	9,699,384.68	5,004,244.71	639.9
Illinois.....	41,460,938.34	19,345,542.33	1,284.7
Indiana.....	17,163,816.81	8,315,678.11	530.0
Iowa.....	27,602,428.68	11,262,792.99	2,038.2
Kansas.....	30,422,761.22	11,321,270.84	994.5
Kentucky.....	15,399,805.47	6,489,735.17	598.6
Louisiana.....	13,373,109.49	5,996,713.08	1,025.5
Maine.....	8,358,953.02	3,999,927.37	288.0
Maryland.....	8,939,352.66	4,211,045.90	320.0
Massachusetts.....	15,499,788.14	5,965,520.13	328.9
Michigan.....	22,755,690.19	10,488,793.25	861.7
Minnesota.....	30,415,685.89	12,738,642.04	2,721.2
Mississippi.....	11,376,090.08	5,530,604.87	872.5
Missouri.....	22,521,233.77	10,706,507.39	1,349.6
Montana.....	10,373,994.98	5,432,829.22	937.7
Nebraska.....	12,966,845.58	6,186,129.95	1,874.7
Nevada.....	6,034,574.22	4,025,094.73	427.8
New Hampshire.....	4,375,744.90	2,085,560.12	215.0
New Jersey.....	13,068,203.04	4,030,694.74	229.6
New Mexico.....	11,716,880.56	6,942,780.42	1,353.0
New York.....	35,294,569.79	14,834,806.53	972.0
North Carolina.....	23,303,899.06	9,685,395.85	1,178.5
North Dakota.....	11,731,991.01	5,695,294.02	2,015.3
Ohio.....	42,755,972.64	15,659,084.19	1,225.6
Oklahoma.....	22,407,594.21	10,421,839.62	910.2
Oregon.....	14,996,187.30	7,510,229.96	829.2
Pennsylvania.....	51,038,049.86	18,532,170.22	987.6
Rhode Island.....	3,154,691.99	1,282,219.05	70.8
South Carolina.....	12,437,758.75	5,600,823.54	1,311.1
South Dakota.....	13,274,837.18	6,580,479.99	1,579.9
Tennessee.....	10,934,117.22	8,304,567.87	586.5
Texas.....	61,999,406.37	24,113,040.85	4,332.3
Utah.....	7,348,884.53	4,505,616.11	487.4
Vermont.....	3,034,811.64	1,462,713.01	108.0
Virginia.....	18,312,886.55	8,669,620.37	859.6
Washington.....	14,488,392.67	6,662,211.87	551.9
West Virginia.....	7,526,593.06	3,321,662.43	335.9
Wisconsin.....	22,665,015.82	9,347,374.28	1,484.6
Wyoming.....	9,643,712.22	5,252,223.22	1,037.8
Total.....	845,263,877.78	373,260,447.14	46,485.5

¹ Figures subject to revision on payment of a few final vouchers now outstanding.² Mileage is of original improvement only.

TABLE 12.—Total program, as of June 30, 1925, of projects which have been approved for construction, completed, and under construction

States	Total cost	Federal aid	Miles
Alabama.....	\$21,721,117.65	\$10,504,803.67	1,441.4
Arizona.....	12,045,158.35	6,533,086.25	804.8
Arkansas.....	21,111,304.41	8,912,138.43	1,479.7
California.....	32,781,771.52	15,765,110.57	1,161.5
Colorado.....	16,659,762.05	8,455,718.46	863.5
Connecticut.....	6,861,371.25	2,524,368.02	138.7
Delaware.....	5,653,541.71	2,042,606.50	138.3
Florida.....	11,863,044.76	5,776,197.57	348.2
Georgia.....	31,925,252.35	15,179,821.83	2,253.8
Idaho.....	12,263,216.79	6,610,751.77	792.1
Illinois.....	48,478,044.84	22,747,452.67	1,524.0
Indiana.....	29,340,487.73	14,176,644.83	878.2
Iowa.....	35,717,255.82	14,880,620.21	2,521.0
Kansas.....	39,625,020.47	15,268,992.44	1,444.5
Kentucky.....	23,721,026.27	10,226,092.83	923.9
Louisiana.....	15,881,666.62	7,189,935.33	1,100.4
Maine.....	9,325,488.71	4,451,897.75	323.5
Maryland.....	11,388,605.43	5,254,169.82	436.5
Massachusetts.....	20,148,478.42	7,080,748.62	395.7
Michigan.....	31,203,535.13	14,404,492.15	1,088.1
Minnesota.....	39,922,009.95	16,803,842.04	3,551.5
Mississippi.....	19,941,448.61	9,805,981.89	1,336.3
Missouri.....	45,255,850.19	19,874,012.47	2,006.5
Montana.....	13,257,681.89	7,421,424.00	1,221.5
Nebraska.....	19,063,120.18	9,132,941.21	2,462.7
Nevada.....	10,114,637.99	7,488,989.87	824.1
New Hampshire.....	5,284,963.53	2,511,945.92	243.2
New Jersey.....	22,505,602.63	7,405,569.80	301.9
New Mexico.....	13,276,986.48	7,927,932.02	1,488.0
New York.....	65,318,395.54	24,342,800.58	1,577.5
North Carolina.....	30,687,729.95	12,938,570.65	1,380.5
North Dakota.....	14,921,438.07	7,337,458.78	2,479.9
Ohio.....	54,372,726.35	19,963,786.33	1,576.2
Oklahoma.....	28,680,690.70	13,427,421.09	1,210.8
Oregon.....	18,015,424.29	9,254,742.91	970.4
Pennsylvania.....	81,009,259.40	26,435,248.03	1,534.7
Rhode Island.....	5,088,995.54	1,773,727.68	100.1
South Carolina.....	18,580,840.57	8,414,936.56	1,644.3
South Dakota.....	20,039,774.14	9,912,403.86	2,513.9
Tennessee.....	26,153,419.06	12,319,834.21	920.6
Texas.....	81,938,512.37	32,528,591.55	5,601.5
Utah.....	9,465,524.65	6,020,365.11	674.5
Vermont.....	4,661,616.12	2,182,635.92	143.3
Virginia.....	24,932,017.80	11,592,157.51	1,083.6
Washington.....	17,201,171.04	7,905,111.87	676.3
West Virginia.....	14,604,159.47	6,163,017.64	525.8
Wisconsin.....	27,149,828.51	11,543,732.98	1,722.4
Wyoming.....	13,171,039.06	7,484,820.46	1,293.4
Hawaii.....	342,277.22	97,440.00	6.5
Total.....	1,182,672,291.58	517,997,101.75	61,129.7

TABLE 13.—*Mileage of Federal-aid roads completed during the fiscal year 1925, by types of construction*

State	Graded and drained	Sand-clay, etc.	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama		29.2	373.4		46.8	31.9			0.9	482.2
Arizona	87.1		29.9			7.5	7.1		1.0	132.8
Arkansas		3.1	67.3	-4.5	31.6	67.0	23.2		.2	188.0
California	33.7		107.1	10.8	9.9	23.1	80.0		.8	265.5
Colorado	20.9	8.4	55.8				47.7		1.5	134.2
Connecticut				8.8			27.9			36.6
Delaware							31.2		.2	31.4
Florida	20.0	12.9			22.7	4.2	40.1		.2	100.2
Georgia	15.3	218.6	76.3	5.2	1.7		6.5	.2	4.4	326.0
Idaho	47.2	.2	65.3						.2	113.1
Illinois	3.0						366.1	1.3	.2	370.5
Indiana	19.3		14.7	7.5	17.0		207.0		1.2	266.8
Iowa	237.2		45.0				67.1		.2	349.6
Kansas	84.5	71.2	15.4		28.0		126.3	10.0	1.7	337.0
Kentucky	91.2		27.4	2.7	23.8				.6	145.7
Louisiana			313.2		9.5				1.6	324.4
Maine			19.1		31.9					51.0
Maryland			2.6		14.3		50.3			67.3
Massachusetts					43.4	5.2	25.1		.8	74.5
Michigan	25.7		95.0		5.0	14.6	147.5	.4		287.8
Minnesota	245.1		114.8				51.1		.1	411.0
Mississippi	60.3	3.2	125.6		1.0	5.8	21.4		.2	217.5
Missouri	98.0		189.1	5.2	10.0	14.9	124.4	.5	1.5	443.5
Montana	22.6		109.0						.3	132.0
Nebraska	133.3	21.6	35.6			2.7	2.7	2.4	.9	155.8
Nevada	3.6	17.9	112.1		5.0		5.8		.9	145.3
New Hampshire			8.2	8.9	16.9	2.3	2.4		.1	38.8
New Jersey	1.6					7.6	61.1		.1	70.4
New Mexico	30.2		427.0				16.1			473.4
New York					50.4	4.8	289.2			344.4
North Carolina	9.8	7.6		5.0	5.0	48.1	122.9		.2	173.4
North Dakota	325.8		54.7			.5			.2	381.1
Ohio	9.2				41.5	3.4	101.3	85.3		240.8
Oklahoma	12.1		247.1			19.5	128.6	2.8	2.7	412.9
Oregon	13.6		120.1				18.9		.4	153.0
Pennsylvania						2.2	154.0	.4		156.6
Rhode Island						5.5	16.2			21.7
South Carolina	10.8	230.2	6.9			15.9	10.4		1.4	275.5
South Dakota	86.1	2.5	394.4						.4	483.3
Tennessee	9.8		33.1	1.7	216.3	14.5	28.9		.1	304.4
Texas	135.0	3.1	565.9	85.9	198.1	27.9	133.4	4.0	17.7	1,170.8
Utah	13.8	37.6	110.2				35.0		.8	169.9
Vermont			21.5	2.0	1.8		7.3		1.0	33.6
Virginia	9.0	20.7	13.6		80.2	7.3	107.3		.6	238.8
Washington	24.3		34.5				23.5		.4	82.7
West Virginia	32.4		.1		2.6	4.9	20.2			60.1
Wisconsin			58.1				69.8			127.8
Wyoming	120.2	89.2	113.7				1.4		1.0	325.5
Total	2,064.1	718.8	4,202.9	129.2	911.9	341.3	2,806.4	107.3	46.7	11,328.6

¹ Negative figures caused by revision of records when final vouchers were paid on projects the type of which was changed after ratification of project agreement.

TABLE 14.—Mileage of Federal-aid roads completed to June 30, 1925, by types of construction

[State]	Graded and drained	Sand-clay, etc.	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama.....	3.2	315.9	651.1	11.6	73.4	86.7	9.6	-----	2.2	1,153.7
Arizona.....	139.8	55.9	342.5	14.2	-----	16.5	99.4	-----	2.2	670.5
Arkansas.....	-----	3.1	727.3	40.3	61.1	243.4	60.4	-----	1.3	1,136.9
California.....	252.5	-----	209.8	18.1	55.5	49.6	359.6	-----	1.8	946.9
Colorado.....	171.4	75.8	296.6	-----	-----	1.0	164.0	-----	3.7	712.5
Connecticut.....	-----	-----	-----	8.8	27.0	-----	82.6	-----	-----	118.4
Delaware.....	-----	-----	-----	-----	-----	-----	109.3	6.2	.2	115.7
Florida.....	20.0	34.1	-----	-----	64.8	12.8	70.7	10.1	.3	212.8
Georgia.....	73.6	1,055.5	286.2	27.4	69.1	11.6	109.9	.5	19.0	1,652.8
Idaho.....	158.6	18.8	402.8	4.3	-----	33.0	21.3	-----	1.1	639.9
Illinois.....	138.1	-----	.4	-----	3.3	8.1	1,114.8	18.6	1.4	1,284.7
Indiana.....	19.8	-----	27.1	7.5	17.0	12.0	445.0	-----	1.6	530.0
Iowa.....	1,251.6	-----	389.4	-----	-----	-----	375.0	22.0	.2	2,038.2
Kansas.....	181.6	88.0	125.2	4.5	56.5	-----	431.4	105.6	1.7	994.5
Kentucky.....	335.8	-----	69.2	41.1	105.8	-----	42.0	3.9	.8	598.6
Louisiana.....	7.4	-----	996.2	3.2	9.5	7.6	-----	-----	1.6	1,025.5
Maine.....	-----	-----	120.5	-----	128.0	-----	39.3	-----	.2	288.0
Maryland.....	3.8	-----	31.5	.1	41.6	12.3	230.7	-----	-----	320.0
Massachusetts.....	-----	-----	-----	3.3	184.4	30.2	109.7	-----	1.3	328.9
Michigan.....	25.7	-----	319.8	18.9	5.0	76.1	415.8	.4	-----	861.7
Minnesota.....	466.1	-----	1,970.7	-----	-----	22.1	261.9	-----	.4	2,721.2
Mississippi.....	181.7	17.6	569.1	11.1	1.0	9.2	73.4	9.2	.2	872.5
Missouri.....	300.1	-----	708.0	13.4	48.9	17.7	252.3	6.2	3.0	1,349.6
Montana.....	215.8	-----	664.9	16.0	6.9	.9	31.3	-----	1.9	937.7
Nebraska.....	1,454.1	141.5	217.1	-----	-----	9.4	37.4	14.3	.9	1,874.7
Nevada.....	73.5	24.9	265.4	-----	20.6	1.6	40.4	-----	1.4	427.8
New Hampshire.....	-----	-----	94.8	32.0	52.8	30.0	4.3	-----	1.1	215.0
New Jersey.....	1.6	-----	3.4	-----	-----	12.6	211.9	-----	.1	229.6
New Mexico.....	221.8	5.1	1,065.3	-----	-----	.7	59.3	-----	.8	1,353.0
New York.....	-----	-----	-----	-----	267.9	4.8	697.1	.7	1.5	972.0
North Carolina.....	78.1	590.4	85.8	12.8	38.0	141.5	232.3	-----	1.6	1,178.5
North Dakota.....	1,648.0	6.5	355.0	-----	-----	1.2	3.0	-----	1.6	2,015.3
Ohio.....	34.2	-----	-----	82.6	246.3	88.1	393.4	380.9	.1	1,225.6
Oklahoma.....	40.4	2.3	526.7	6.3	.6	64.5	257.5	4.0	7.9	910.2
Oregon.....	110.2	-----	553.7	25.6	-----	52.9	85.7	-----	1.1	829.2
Pennsylvania.....	-----	-----	-----	-----	7.8	101.9	852.7	25.2	-----	987.6
Rhode Island.....	-----	-----	-----	-----	10.5	37.0	23.3	-----	-----	70.8
South Carolina.....	10.8	1,105.4	100.9	-----	3.0	38.0	49.0	.2	3.8	1,311.1
South Dakota.....	281.7	2.5	1,293.8	-----	-----	-----	.8	-----	1.1	1,579.9
Tennessee.....	13.1	-----	94.4	52.3	363.4	21.9	50.8	-----	.6	596.5
Texas.....	303.8	61.2	2,756.2	448.0	309.3	77.7	329.5	24.8	21.8	4,332.3
Utah.....	101.1	37.6	242.3	9.3	-----	7.8	88.0	-----	1.3	487.4
Vermont.....	-----	-----	72.8	3.4	19.7	-----	10.8	-----	1.3	108.0
Virginia.....	27.0	199.7	84.7	108.5	186.2	10.6	241.6	-----	1.3	859.6
Washington.....	52.4	-----	296.8	-----	-----	-----	200.9	-----	1.8	551.9
West Virginia.....	138.5	1.7	18.3	4.9	69.7	16.3	74.9	11.4	.2	335.9
Wisconsin.....	233.6	140.5	731.9	2.7	9.6	-----	366.3	-----	.1	1,484.6
Wyoming.....	310.8	462.3	246.2	-----	-----	1.2	14.3	-----	3.0	1,037.8
Total.....	9,079.2	4,446.3	18,013.8	1,032.2	2,564.2	1,370.5	9,234.6	644.2	100.5	46,485.5

TABLE 15.—*Mileage of total Federal-aid program as of June 30, 1925, by types of construction*

States	Graded and drained	Sand-clay, etc.	Gravel	Water-bound macadam	Bituminous macadam	Bituminous cement concrete	Portland cement concrete	Brick	Bridges	Total
Alabama	53.1	366.2	795.6	11.6	73.4	86.7	51.1		3.7	1,441.4
Arizona	168.7	93.1	395.3	14.2		22.7	108.6		2.2	804.8
Arkansas		3.1	939.2	70.8	109.7	250.4	104.4		2.1	1,479.7
California	319.4		283.1	18.1	62.1	62.2	413.9		2.6	1,161.5
Colorado	200.7	75.8	386.8			1.0	195.6		3.7	863.5
Connecticut				8.8	27.0		102.8			138.7
Delaware							131.9	6.2	.2	138.3
Florida	46.5	34.1		36.5	72.6	41.8	97.7	10.1	8.9	348.2
Georgia	154.0	1,385.3	373.5	59.3	105.5	14.5	137.2	.5	23.9	2,253.8
Idaho	176.7	18.8	516.3	4.3		42.3	32.8		1.1	792.1
Illinois	138.1		.4		3.3	8.1	1,354.0	18.6	1.5	1,524.0
Indiana	25.7		32.1	46.5	17.0	12.0	730.9	11.0	3.0	878.2
Iowa	1,528.9		441.8				527.8	22.0	.4	2,521.0
Kansas	421.2	105.4	199.6	4.5	125.7	.4	459.9	125.0	2.8	1,444.5
Kentucky	559.4		76.8	51.5	138.2		93.2	3.9	.8	923.9
Louisiana	29.2		1,040.9	3.2	9.5	10.4	3.6		3.6	1,100.4
Maine			135.8		142.0	5.3	39.3		1.3	323.5
Maryland	3.8		31.5	.1	41.6	12.3	347.2			436.5
Massachusetts				3.3	207.2	30.2	153.2		1.8	395.7
Michigan	30.5		329.9	18.9	10.4	76.1	621.9	.4		1,088.1
Minnesota	966.5		2,264.6			22.1	297.8		.6	3,551.5
Mississippi	245.5	17.6	887.4	11.1	1.0	19.1	144.8	9.2	.7	1,336.3
Missouri	468.0		819.6	13.4	60.2	17.7	597.3	21.0	9.3	2,006.5
Montana	252.6		911.5	16.0	6.9	.9	31.3		2.3	1,221.5
Nebraska	1,718.7	211.9	465.9			10.1	37.4	14.3	4.3	2,462.7
Nevada	83.6	24.9	645.2		20.6	1.6	45.6		2.6	824.1
New Hampshire			98.6	40.3	64.1	31.9	5.2		3.1	243.2
New Jersey	3.5	.8	3.4			12.6	280.2		1.5	301.9
New Mexico	228.5	5.1	1,183.5			.7	69.3		.8	1,488.0
New York	6.7		54.4		356.7	11.8	1,145.7	.7	1.5	1,577.5
North Carolina	127.1	590.4	85.8	12.8	42.7	190.4	329.1		2.1	1,380.5
North Dakota	2,050.7	6.5	416.3			1.2	3.0		2.4	2,479.9
Ohio	67.2			104.9	339.4	93.8	533.1	437.8	.2	1,576.2
Oklahoma	137.4	2.3	607.0	6.3	.6	72.4	371.7	4.0	9.1	1,210.8
Oregon	166.1		631.5	25.6		52.9	92.3		2.0	970.4
Pennsylvania	65.3				7.8	101.9	1,334.5	25.2		1,534.7
Rhode Island					16.2	38.3	45.5			100.1
South Carolina	22.4	1,349.9	146.1		3.0	48.2	66.2	.2	8.2	1,644.3
South Dakota	821.2	2.5	1,686.5				.8		2.8	2,513.9
Tennessee	177.1		106.3	52.3	421.0	21.9	140.5		1.5	920.6
Texas	734.7	73.6	3,162.5	516.3	485.7	97.7	479.0	29.2	22.7	5,601.5
Utah	101.1	37.6	424.7	9.3		7.8	92.1		1.8	674.5
Vermont			88.1	3.4	31.7		17.8		2.5	143.3
Virginia	62.6	202.7	116.5	114.3	261.4	10.6	314.1		1.6	1,083.6
Washington	121.7		320.4				232.2		2.1	676.3
West Virginia	199.7	5.6	27.0	7.9	109.2	40.8	123.8	11.4	.5	525.8
Wisconsin	242.9	140.5	887.5	2.7	13.8		434.9		.1	1,722.4
Wyoming	478.8	470.8	320.2			1.2	18.4		4.0	1,293.4
Hawaii						6.5				6.5
Total	13,405.4	5,224.6	22,339.3	1,288.1	3,387.2	1,590.4	12,990.6	750.7	153.9	61,129.7

TRANSCONTINENTAL HIGHWAYS DESIGNATED

As the result of the general improvement in the condition of roads throughout the country and the greatly increased use of motor vehicles the range of travel by highways has been so extended that transcontinental journeys are by no means uncommon. In consequence of this development the early improvement of a limited number of transcontinental routes and the uniform marking of

such roads by all States has become one of the most pressing needs.

The State highway departments, recognizing their responsibility in this respect and believing the matter to be one requiring joint action by the several State highway departments and the Federal Government, the American Association of State Highway Officials recommended that the Secretary of Agriculture appoint a joint board of Federal and State officials to designate the transcontinental routes and decide on a uniform

marking system. In response to this recommendation the Secretary appointed the joint board on interstate highways in February, 1925, selecting as members 24 representative Federal and State highway officials.

At the first meeting of the board in Washington on April 20, a series of cautionary, directional, and informational signs was tentatively decided upon subject to approval by the several State highway departments to which they were submitted in a number of regional meetings. At these regional meetings members of the board also received from the State highway departments their recommendations with regard to the routes to be designated. These recommendations were considered and harmonized at a second meeting of the board held in Washington on August 3, as the outcome of which a definite system of transcontinental roads was designated and standard signs for use by all States on the designated system were adopted.

The transcontinental routes designated are all included in the Federal-aid highway system. Their designation and adoption by all States is an accomplishment of the highest order, carried out in a splendid spirit of co-operation by the Federal and State departments. Its immediate effect should be to facilitate compliance with section 6 of the Federal highway act which requires that the Secretary of Agriculture shall give preference in approving projects to those which will expedite the completion of an adequate and connected system of highways interstate in character.

Preferential consideration given to the improvement of the designated transcontinental system should at a very early date result in the complete improvement of the system, and the uniform numbering and signing of the system in all States will be of inestimable value in promoting the safety and convenience of the highways used by interstate traffic.

FOREST-HIGHWAY IMPROVEMENT

The forest-highway systems have been definitely selected and approved by the Secretary of Agriculture in all

States except Oregon and New Mexico, and all funds available for forest-highway improvement are being expended only on the approved systems. In Oregon and New Mexico, approval of projects is being limited to the systems recommended by the Bureau of Public Roads pending final agreement of the cooperating agencies on systems which can be approved by the Secretary.

The total mileage of the approved systems, including the mileage in the recommended Oregon and New Mexico systems, is 13,396 miles. Of this total, 1,043 miles are class 1 highways, i. e., roads which are necessary sections or extensions of the Federal-aid system wholly within the national forests. Class 2 roads, which are extensions of the Federal-aid system and partly within or adjacent to and serving the national forests, have a total length of 6,904 miles; and class 3 roads, which are roads of primary importance to counties or communities within the forests, have a total length of 5,449 miles. Of the total mileage selected, 4,011 miles or approximately 30 per cent are necessary sections of the Federal-aid highway system.

In the forest-highway work as in the Federal-aid road work the progress made during the last fiscal year was very gratifying. The initial improvement of 603 miles and the betterment of 78 miles previously improved is a year's record which has not been exceeded in any previous year except 1921, when 729 miles were added.

Of the 681 miles improved initially or by betterment of type during the year, 635 miles were in 12 States of the far West and the Territory of Alaska, the balance of 46 miles being located in the States of Arkansas, Florida, Georgia, and Tennessee. The total cost of the completed roads was \$8,658,516, of which \$8,470,516 was expended in the Western States and Alaska.

The total mileage of forest roads improved by the Bureau of Public Roads up to the close of the fiscal year was 2,429 miles. The mileage and cost of the roads completed in each State during the fiscal year are given in Table 16.

TABLE 16.—*Forest highways completed during the fiscal year 1925*

State	Mileage completed	Total cost	Remarks
	<i>Miles</i>		
Alaska.....	29.5	\$527,947.96	Includes 3.6 miles of surfacing only.
Arizona.....	62.1	435,908.18	Includes 23.4 miles on which only drainage structures were added.
California.....	40.4	823,886.69	Includes 10.9 miles of surfacing only.
Colorado.....	35.8	588,376.39	
Idaho.....	107.4	1,647,953.24	Includes 7 miles of clearing only.
Montana.....	51.5	685,051.55	Includes 7.1 miles of clearing only.
Nevada.....	58.9	401,723.94	
New Mexico.....	11.5	163,001.11	
Oregon.....	114.2	1,847,121.43	
South Dakota.....	8.5	108,416.04	
Utah.....	53.0	320,043.12	Includes 6.3 miles widened and 20 miles improved.
Washington.....	24.2	557,567.36	
Wyoming.....	38.5	363,519.15	
Arkansas.....	10.8	95,499.34	
Florida.....	28.6	82,134.47	
Georgia.....	.1	10,365.85	Bridge.
Tennessee.....	6.5	10,366.85	
Total.....	681.5	8,668,882.67	

In addition to the mileage of forest roads completed there was under construction at the close of the fiscal year 931.87 miles, including 135.87 miles of roads previously constructed as earth roads and now being surfaced. It is estimated that this work will cost more than \$12,000,000. The disbursements up to the close of the year were \$8,256,012.

The forest roads constructed under the supervision of this bureau are those which are of primary importance to the States and to counties and communities located within and adjacent to the forest areas. Forest-development roads and trails are constructed mainly under the supervision of the Forest Service.

Because of the large extent of the forest reservations in the Western States, and especially by reason of the fact that their location follows approximately the mountain ranges, so that they include the important mountain passes, no interstate highway system can be complete which does not include connections across the forest areas.

Such connections, imperatively required from the economic standpoint, also serve to make accessible to the increasing army of motor tourists the scenic beauties in which the forests abound. Moreover, as the national parks are practically surrounded by forests, in almost every case approach to the parks by motorists is dependent upon the construction of the main roads through the forests.

It is especially desirable, therefore, that the activities of the State highway departments and those of this bureau, the Forest Service, and the National Park Service shall be closely correlated. The highway work of each of these agencies should be so correlated that continuous routes leading to and through the national parks and forests shall be built as speedily as possible, leaving the lesser routes for later development.

In view of the desirability of such a correlation of effort it is gratifying to report that an arrangement has been perfected during the past year under which the Bureau of Public Roads will cooperate with the National Park Service by making surveys, plans, and estimates for roads to be constructed in the national parks and by superintending the construction of major projects. The bureau will also be consulted in a general way on all national-park road work.

The transmountain highway in Glacier National Park, Mont., has already been let to contract under this arrangement. This project, which is one of the most important, is a part of one of the transcontinental highways. It lies between Lake McDonald and St. Mary Lake and connects the two via Logan Pass. In making the survey for the project every effort was made to preserve and make accessible the scenic features of the park as well as to provide a safe and comparatively light grade for the highway.

In addition to the transmountain highway surveys have been made in the Grand Canyon National Park, Hawaii National Park, and Rainier National Park, and others are under way in the Rocky Mountain, Sequoia, Yosemite, Yellowstone, Zion, and other parks.

SURPLUS WAR MATERIALS

Except the explosives, of which there is still a supply to be distributed, the distribution of war materials declared surplus by the War Department is now practically completed. Since the fiscal year 1920, when the distribution was begun, materials of an estimated value of more than \$247,000,000 have been distributed to State highway departments, other branches of the Federal establishment, and to farmers.

The materials shipped to State highway departments have been supplied for use in highway construction, and the aid extended in this way has been in many ways as helpful as the monetary aid. The value of the material received by the States up to the close of the fiscal year was more than \$215,000,000. Materials transferred to branches of the Federal Government other than the Bureau of Public Roads are valued at more than \$18,500,000 and the explosives distributed to farmers for use in land clearing and other agricultural operations are valued at more than \$5,600,000.

The estimated total value of all material delivered to consignees up to the close of the fiscal year is given in Table 17.

TABLE 17.—*Estimated total value of all surplus war material delivered up to the end of the fiscal year 1925*

Consignee	Estimated value	Consignee	Estimated value
U. S. departments and establishments:		States, for road building—Contd.	
Department of Agriculture—		Georgia.....	\$7,219,278.27
Bureau of Public Roads.....	\$7,792,732.30	Idaho.....	2,157,856.72
Other bureaus.....	2,278,157.64	Illinois.....	8,174,245.20
War Department.....	9,823,358.09	Indiana.....	8,398,286.59
National cemeteries.....	615.00	Iowa.....	7,633,605.99
Navy Department.....	57,838.00	Kansas.....	5,411,802.69
Marine Corps.....	168,411.70	Kentucky.....	3,908,613.33
Post Office Department.....	939,160.00	Louisiana.....	3,365,830.68
Treasury Department, Public Health Service.....	19,225.34	Maine.....	1,800,026.44
Interior Department—		Maryland.....	2,431,855.22
Indian Service.....	111,979.50	Massachusetts.....	2,115,668.47
National Park Service.....	318,848.25	Michigan.....	9,868,032.09
Reclamation Service.....	89,140.00	Minnesota.....	4,527,332.15
St. Elizabeths Hospital.....	46,723.00	Mississippi.....	3,183,592.46
Alaska Railroad.....	9,225.00	Missouri.....	5,688,797.22
Miscellaneous.....	9,028.00	Montana.....	3,018,929.95
Department of Justice.....	175,000.00	Nebraska.....	3,297,288.49
Veterans' Bureau.....	3,808,941.00	Nevada.....	1,800,117.20
Board of Road Commissioners for Alaska.....	86,727.84	New Hampshire.....	984,711.98
The Panama Canal.....	155,060.59	New Jersey.....	2,948,515.46
U. S. Soldiers' Home.....	18,339.90	New Mexico.....	3,899,666.90
U. S. Shipping Board.....	62.88	New York.....	11,345,425.61
U. S. Housing Corporation.....	4,730.00	North Carolina.....	6,966,295.77
Government Printing Office.....	2,150.00	North Dakota.....	2,331,000.98
District of Columbia.....	575,188.28	Ohio.....	7,092,805.69
Total to U. S. departments and establishments.....	26,490,643.31	Oklahoma.....	3,801,188.01
Farmers, for land clearing.....	5,662,884.10	Oregon.....	3,703,599.98
Total to U. S. departments, etc., and farmers.....	32,153,527.41	Pennsylvania.....	5,996,746.56
States, for road building:		Rhode Island.....	655,788.25
Alabama.....	3,063,797.01	South Carolina.....	4,703,811.62
Arizona.....	4,021,944.60	South Dakota.....	4,139,630.94
Arkansas.....	2,875,257.56	Tennessee.....	6,102,441.21
California.....	7,365,573.81	Texas.....	11,227,259.99
Colorado.....	4,378,788.64	Utah.....	1,940,129.00
Connecticut.....	1,003,206.38	Vermont.....	789,402.25
Delaware.....	495,684.70	Virginia.....	7,529,778.87
Florida.....	5,015,226.87	Washington.....	4,012,889.46
		West Virginia.....	5,729,278.72
		Wisconsin.....	4,734,276.34
		Wyoming.....	2,169,752.77
		Total to States for road building.....	215,025,035.09
		Grand total.....	247,178,562.50

RESEARCH AS AN AID TO ADMINISTRATION

The building of a national highway transportation system is a trust which the bureau feels can not be faithfully administered without constant effort to broaden the field of scientific knowledge of the materials and processes employed in the construction. The highway researches of a physical and economic character in which it has been engaged for a number of years are regarded, therefore as a highly important department of the work.

During the past year the most significant results have been obtained in three branches of this work. A field study and careful analysis of the elements affecting the cost of grading and concrete paving have led to the development of managerial methods the application of which in test projects has cut costs of construction virtually in half. No more practical or immediately beneficial study has ever been made by the bureau. The second result of importance has been the development of methods of analyzing the flow of traffic over a highway system and the application of the results of such analysis to the economic improvement of the system. These methods applied in California, Maine, Connecticut, Pennsylvania, Ohio, and Cook County, Ill., have been instantly recognized by the State and local officials as a most valuable aid to administration. The third outstanding advance is that which has rewarded the prolonged study of highway subgrades. Practical methods have been devised for the identification of suitable soils, and there is reasonable ground for hope that corrective treatments will soon be developed that will make it possible to overcome the handicap of unsuitable soils.

In the analysis of construction costs the first work was a study of the operation of earth-moving equipment. Beginning with the lighter equipment, such as slip scrapers, wheelers, and fresnos, the investigations were later extended to include the operation of elevating graders, steam shovels, drag lines, and dredges. Each type of equipment has been studied in operation with the object of determining the extent of the preventable time losses. Such losses have been detected even on well-managed proj-

ects, their presence wholly unsuspected by the contractor because of the lack of a detailed study of the operations involved in the work. Once detected it is a comparatively simple matter to eliminate them by careful management; and the tests made indicate that savings of from 25 to 35 per cent of the earth-moving cost may generally be made on average projects.

The concrete-paving studies have had a similar purpose, i. e., to develop precisely the reasons why production so commonly fails to reach rates theoretically attainable. The observations made have clearly established these reasons, and the bureau has induced a number of contractors to make the changes in operating methods shown to be necessary with the most striking results.

In one case production under the contractor's management had averaged 36 lineal feet of pavement an hour and about 180 feet a day. As a result of suggestions made by the bureau's engineers production rose steadily during the test period of about a month to an average of 62.5 feet an hour attained during the last nine days and the daily production increased even more sharply as a result of the elimination of heavy time losses which had the effect of increasing the length of the working day. The effect of this improvement was to reduce the labor cost from \$0.457 per square yard, which had been the average cost to the contractor, to \$0.203 per square yard.

On another project the contractor's production had averaged 64 feet an hour and 486 feet a day. The suggestions made by the bureau's representative raised the output to a 7-day average of 97 feet an hour and a maximum of 101 feet for 12½ hours, a day's run of 1,263 feet. In this case labor had cost the contractor \$0.207 per square yard of pavement laid as against a cost of \$0.128 per square yard for the last week of the test period. Under the contractor's management 35,743 square yards were laid in slightly over two months, while during the last week of the test period 10,096 square yards were laid, and this in spite of the fact that of the six working days, one-half day was lost on account of rain and another half day at the end of the period by the completion of the pavement to be laid at noon of the last day.

PHYSICAL RESEARCHES AND TESTS

These investigations, in general, cover researches the aim of which is to establish facts which will lead to more durable and economical pavement design, more economical use of road materials and better combinations more suitable for present day heavy motor-truck traffic, and finally, to obtain data which will serve as the basis for legislation pertaining to motor vehicles in their relation to the highways.

Subgrade materials.—The work on subgrade materials is one of the major research projects. This work is subdivided under several headings, which include bearing value, determination of physical characteristics of subgrade materials, the effect of moisture, and the effect of alternate freezing and thawing; also field investigations to determine what method of treatment is necessary to properly prepare and improve a subgrade preparatory to building the road surface. A tentative classification of subgrade material has resulted which aids in interpreting and predicting subgrade conditions. This classification requires the determination of several physical characteristics, the tests necessary for which have been further revised and developed. The methods of examination, testing and treatment of subgrade materials and subgrades, while very greatly advanced, are not fully satisfactory in their practical application, and the main effort during the past year, which effort is to be extended, has been to develop simple and practical methods. A general subgrade map of the United States has been prepared.

Measurements of stresses under actual road conditions.—This subject includes the determination of actual stresses and deflections of concrete roads of different designs and of specially constructed roads under the influence of actual traffic. As a result of the investigation the distribution of stresses in road slabs under heavy traffic has been discovered and this investigation in connection with others already conducted has resulted in a more rational method for the design of concrete road surfaces. These researches on road design have undoubtedly had very great influence in producing much more durable and economical pavements throughout the country than have been built in the past, and millions of dollars were saved in the past year alone through the use of designs thus established. Thirty-three

of the States have now adopted the design which these investigations and others have brought about.

Bridge design.—A series of tests to determine the action and strength of skew arches has just been finished. These studies have been conducted over a period of two years. Some very definite and positive results have been obtained showing the distribution of the load reactions and thrust on skew arches, which are of vital interest to engineers engaged in bridge design.

Measurement of impact of motor trucks.—This project has been conducted in cooperation with The Rubber Association of America and the Society of Automotive Engineers over a period of about two years. Its purpose is to determine the destructive effect of motor trucks on road surfaces. The impact of motor trucks has been determined under a variety of conditions of load, speed, type of truck, tire equipment, and character of road surface, and the results of the tests have made it possible to predict the relative effect of motor trucks on roads under the several conditions.

Nonbituminous road materials.—Miscellaneous small tests have been conducted to establish particular facts in connection with the use of materials from certain sources of supply. As the result of these special tests, materials have been made available for use which previously had been thought to be unsuitable. Additional work has been done during the past year in devising an abrasion test for concrete sands which will indicate the quality of the grains. A number of samples of sand have been subjected to a special abrasion test using the Deval abrasion cylinder, and preliminary conclusions indicate that the test gives, in general, a good idea of the durability of the grains.

A considerable amount of work has been done on the question of size and shape of screen openings for sieving. This is a matter which is involved in specifications for materials and which has caused considerable trouble in the past.

A new device has been constructed, after investigation, which satisfactorily measures the consistency of concrete in the field as well as in the laboratory. In view of the established fact that the proper consistency is the chief factor in controlling the strength of concrete, the importance of this development can not be over-emphasized. Its use should make pos-

sible the construction of concrete structures of considerably higher strength and greater durability than those built in the past.

Apparatus has also been devised for measuring the pressure in molding cement briquettes, which will make for greater uniformity in testing and correspondingly less contention in regard to the acceptance of cement based on tests. Tests have also been conducted looking toward the determination of the effect of quality of cement on the compressive strength of Portland-cement concrete. An extensive series of tests has been run on high-alumina cement, which recently has been used extensively for special work in connection with highways and bridges. These tests aid in establishing the limitations of the cement, the conditions under which it should be used, and the way it should be handled.

A series of investigations to determine the cause of scaling of concrete roads has also been finished. Five hundred and twenty-six specimens of concrete were subjected to freezing and thawing, and the various factors thought to be productive of scaling were investigated. Many of the specimens scaled or completely disintegrated in from 40 to 140 alterations of freezing and thawing.

Bituminous road materials.—A second series of 33 experimental test sections was constructed on the circular roadway at the Arlington Experimental Farm during July, 1924, comprising among others five pavements employing as many different sand mixtures. The latter were designed for the particular study of variations in proportions of the mixture. After the installation of devices for the measurement of temperatures and movement of the pavement, traffic was operated from August to November, using a loaded 5-ton motor truck. The effect of traffic was observed almost immediately on certain sections, diminishing as the weather became cooler. Traffic was resumed in the spring and is now demonstrating decided differences in behavior between a number of the sections.

Closely related to the latter investigation is the one involving laboratory tests of the same mixtures used in the circular track tests. These tests furnish a means of correlating service behavior with laboratory determinations of relative stability for the many possible combinations of materials. The first phase of the laboratory investigations is the development

of a test or tests for differentiating between mixtures of known behavior under traffic and evaluating their relative resistance to displacement. The laboratory has concentrated on this problem during the past year and has developed, first, a method of forming the test specimens and, second, a test by which the resistance of the specimens to deformation in a confining mold is measured. The testing procedure was recently described in a paper delivered before the American Society for Testing Materials. Results obtained during the development of the test are very promising, and a continuation of the study will furnish an increasing fund of data to be used in the determination of those proportions and characteristics of the asphalt, sand, and dust which will prevent or limit the waving of asphalt pavements under heavy traffic.

The work of standardizing bituminous materials and methods of testing is carried on largely in cooperation with technical committees of Government and national organizations. Assisting in the work of the Federal Specifications Board, the bureau has taken part in compiling a series of specifications for bituminous and nonbituminous road materials. Those for the most important bituminous materials have been adopted by the board, and those for nonbituminous materials are now in the final stages of their preparation. The bureau has also assisted in the work of the technical committee on liquid fuels and lubricants. In connection with the work of the American Society for Testing Materials, in addition to general participation in the discussions of committees, laboratory work has been accomplished on extensive studies of tests for the asphaltic content of road oils and the distillation of tars or similar products.

Field experiments.—Field experiments have been conducted with the object of improving the service value of the low-type roads such as earth, sand-clay, top soil, and gravel. In Iowa and South Dakota short experimental sections of earth road have been constructed with admixtures of hydrated lime and Portland cement, with the idea of stabilizing the soil and rendering it less muddy in wet weather. In South Carolina two experimental sections have been constructed involving the surface treatment of top-soil roads in different ways and with different kinds of bituminous materials. Preliminary work has also been begun on a special experiment on the Mount

Vernon-Gum Spring Road in Virginia, which will later be given special treatments in further development of this type of surfacing for automobile and motor-bus traffic.

Cooperative investigations.—The cooperative researches with a number of institutions were continued during the past year, involving investigations of road materials, subgrade materials, design, and economics. The agencies engaged in cooperative work with the bureau and the general subjects of their investigations are as follows:

Purdue University: Investigations on highway concrete.

Iowa State College: Tractive resistance of motor vehicles, highway-bridge impact, loads on highway culverts, and effect of pavement characteristics on fuel consumption.

University of Georgia: Sand-clay and topsoil road investigations.

Kansas State College: Wind-resistance investigations.

University of Kansas: Tire wear as affected by the type of road.

Pennsylvania State Highway Department: Guard-rail investigations and special investigations of concrete highway design.

Ohio State University: Field and laboratory investigations of subgrades.

Johns Hopkins University: Physical investigations of concrete under impact.

Cooperation was also given to the Delaware River Bridge Joint Commission in connection with the floor system and pavement of the new Delaware River suspension bridge between Philadelphia and Camden.

Testing highway materials.—Routine examinations of both bituminous and nonbituminous road materials is one of the important functions of the bureau laboratories. These examinations are made primarily on materials used in Federal-aid road construction or in the construction of forest roads. Results of tests on such materials are sent to a large number of laboratories performing tests on Federal-aid samples in order that these laboratories may have a check on their results against those obtained by the bureau. Cooperative tests were conducted with approximately 50 of the road materials testing laboratories of the country, and a number of tests were made in cooperation with laboratories at their special request in order to check their personnel and equipment. Instruction in materials testing was given to personnel from four of the district offices.

ECONOMIC RESEARCHES

The purposes of the bureau's highway economic research are to obtain the facts and determine the principles which must be the basis of the planning and construction of the highway system which will produce the most adequate and economical highway service. These fundamental purposes may be summarized under the following headings:

(1) To further apply business principles to highway planning and administration. This involves an analysis of the demand for highway service and a study of the most efficient and economical methods of providing it.

(2) To establish scientific methods of planning a highway system, and to set up scientifically planned highway development programs. This involves two factors:

(a) The determination of the highway improvements which are economically justified by the comparison of costs of the improvement with the value of the service yielded by the improvement, and

(b) The planning of the highway development program which will yield the maximum service for a given expenditure of funds, and the scientific determination of the order of improvement of the various highways within the system.

(3) To establish sound and equitable principles governing the distribution of highway costs. A scientifically planned highway system can not be developed unless the costs of the improvement are equitably distributed in proportion to the service yielded. The establishment of sound principles of highway finance requires an accurate evaluation of the service of the highways to various individuals and classes of society, the analysis of the present distribution of highway costs, and the comparison of these costs with the value of the service.

(4) To determine the place of highway transportation in our transportation system, and to establish the principles of coordination between highway transportation and other forms of transportation in order to develop the most efficient general transportation system. This involves a study of the present uses and volume of highway transportation, and a comparison of highway transportation with other methods of transportation with reference to costs, service, stability, and probable future development.

TYPES OF ECONOMIC RESEARCH

With these purposes in view a comprehensive program of economic research has been inaugurated and is progressing rapidly. Highway transportation and highway planning investigations have been completed in California, Connecticut, Maine, and Cook County, Ill. Field work has been completed on a similar project in Pennsylvania, and similar work is now in progress in Ohio. These investigations include the collection of complete traffic data upon the highway system of each area and provide basic data required for the establishment of a scientific improvement program, as well as very valuable information regarding highway transportation in relation to other forms of transportation.

A series of investigations dealing more particularly with the field and scope of motor-truck transportation, and supplementing the data obtained in the transportation and planning investigations, is also in progress. The results of studies of motor trucking in the Chicago metropolitan area, made in connection with the Cook County transportation survey, and dealing with the organization, operation, and costs of motor trucking, together with trucking rates and principal commodities hauled by motor truck, will soon be ready for publication. Similar investigations are also in progress in the New England and Middle Atlantic States.

A third type of research, dealing with the problems of highway financing, is also in progress. Large highway revenues are annually collected from rural real estate through general property taxes and also, in some jurisdictions, through special assessments for highway construction. It is the purpose of this series of investigations to measure quantitatively the effect of highway improvements upon the value of rural land and to compare this effect with the cost to the land of the highway improvements. Field work of this investigation has been completed in selected areas of the State of Iowa and in an intensive dairying area of southern Wisconsin and northern Illinois. Data will also be obtained in selected areas of Ohio. The report of these studies will be made upon completion of the field work in Ohio.

RESULTS OF PLANNING STUDIES TO DATE

These studies, which have been undertaken in California, Connecticut, Maine, Ohio, Pennsylvania, and Cook County, Ill., have produced a great deal of information of special value to the authorities exercising jurisdiction over the highways of the several areas. In the State areas the problems have involved mainly the determination of the relative density and character of traffic on the various roads constituting the State highway system, the probable increase over a period of years, and the value of the traffic as a basis for a definite program of improvement and a fair distribution of the cost.

In Cook County the problem was considerably more complicated, the need more urgent, and the findings and recommendations are therefore of particular interest. A serious condition of congestion exists on the county highways adjacent to the city of Chicago. This condition, recognized by city, county, and State authorities, prompted the making of the survey as a means of establishing the facts of the situation and indicating the remedies.

It is not possible in this report to refer to the details of the findings and recommendations in each area, but there are a number of general conclusions, common to all, the more important of which may be mentioned as follows:

(1) It is possible by such investigations to indicate not only the highways upon which the need for improvement is greatest but also to indicate the type and design required to carry the traffic adequately on any route. They also prevent errors in the selection of routes for improvement and in the selection of proper type and design for these improvements. The prevention of such errors on one route may result in a saving equal to the entire cost of the investigation.

(2) The classification of highways on the basis of present and future traffic importance and the selection of the most suitable type of highway surface to serve traffic depends upon the type of traffic units as well as the number of these units. The more important considerations are:

(a) Density of present and future total traffic.

(b) The ratio of trucks to total vehicles.

(c) The proportion of trucks of large, medium, and small capacity.

(d) The maximum wheel loads.

(e) The frequency of heavy gross loads and wheel loads.

In individual cases other factors must be considered, but in general the most important considerations are those above mentioned. The final selection of the type of highway surface depends upon certain physical considerations, such as topography, drainage, soil and subgrade conditions, availability and cost of materials, as well as upon traffic considerations.

(3) A definite program of the order of improvement of various highways is essential to the production of efficient and economical highway service. Investigations in the several States have demonstrated the urgent need for improvement of certain highway routes or sections of such routes. Unimproved or insufficiently improved sections of important traffic routes prevent the full utilization of the entire route. To obtain the maximum service from the highway system it is essential that these sections be given priority in the improvement program. Investigations also indicate that upon insufficiently improved important traffic routes maintenance costs become excessive. In the interest of economy as well as of highway service such routes must be given priority in the improvement program.

(4) The traffic importance of the various roads of the highway system provides the only proper index for the distribution of highway funds.

(5) The location and design of highway improvements must consider future developments in traffic as well as present traffic. Investigations completed indicate that in various areas traffic using the highways in 1930 will be from 100 to 120 per cent greater than in 1924. Highway programs must be developed to adequately serve this great expected increase in traffic.

(6) Important passenger-traffic routes are in general identical with important truck-traffic routes. The ratio of trucks to passenger cars varies considerably on different routes, but exclusive trucking or exclusive passenger-car routes are practically unknown in the States where traffic has been analyzed, and important passenger-car routes that are not also important trucking routes, or vice versa, are few in number.

(7) Important traffic routes are generally found in the areas of dense population and intensive industrial development. The population and industrial development of the area served by highways are important factors in the determination of the traffic upon the route. On highways connecting two centers of population the population and industrial development of the centers and the distance between them are important traffic factors. This relationship between population and highway traffic indicates the necessity of considering population and industrial distribution in the planning of a highway system.

(8) Highways in the proximity of important industrial centers not only carry a large number of trucks but also carry a high proportion of large-capacity trucks with resulting heavy gross, axle, and wheel loads.

(9) On heavy-traffic routes considerations of economical highway service as well as of safety demand the removal of every obstruction to the free flow of traffic. Traffic congestion points such as railway intersections, important highway intersections, traffic "bottle necks," narrow bridges, and narrow or partly obstructed streets in villages through which the route passes, lower the capacity of the entire route and are economically unjustified.

(10) The provision of adequate entry ways for heavy-traffic routes into large cities is an important highway-planning problem. The convergence of several routes at one city gateway and the lack of adequate connections between these highways and city streets are frequent causes of congestion. In the congested-traffic areas adjacent to the larger cities traffic-sorting routes and belt highways as well as adequate city connections are essential.

(11) The development of a highway system to adequately serve traffic needs, particularly in the suburban areas surrounding large cities is frequently obstructed by the lack of provision of adequate right of way. A scientific plan of highway development should include the acquisition of right of way adequate to provide efficient service for the expected development of the area. Unless such right of way is acquired before the development of a suburban area, special-use districts, such as railway yards, industrial plants, parks, etc., may prevent the natural development of the highway system as well as

greatly increase the cost of future acquisition.

(12) Highway traffic, both of passenger cars and motor trucks, is predominantly local in nature. Long-distance movement is important on certain routes, but even in these cases the long-distance traffic is a relatively small part of total traffic. The results of the Connecticut transportation survey indicate that 55.7 per cent of all passenger cars make an average trip of less than 20 miles and 72 per cent less than 40 miles.

(13) Truck traffic is primarily a short-haul movement. The average trip mileage varies considerably in different areas, but in the areas studied between 55 and 70 per cent of all loaded trucks travel less than 20 miles per trip, and between 75 and 80 per cent have an average trip mileage of less than 30 miles.

THE MOTOR-TRUCK INVESTIGATIONS

The investigations dealing more particularly with the field and scope of motor-truck transportation and its coordination with other types of transportation are still in progress and conclusions are therefore less definite. The following important conclusions are evident:

(1) The movement of consumption goods and other goods to their place of final use is the most important motor-trucking movement. The hauling of perishable foodstuffs forms an important part of this movement.

(2) In the Chicago area it was found that the hauling by motor truck of perishable foodstuffs originated at railway team tracks, auction-house team tracks, storage houses, boat wharves, railway express terminals, parcel-post terminals, and at original producers in the territory surrounding the terminal area.

(3) In the same area the principal factors affecting the movement of perishable commodities by motor truck are:

(a) The nature of the commodity. Highly perishable commodities must be moved at once, either to market or to storage.

(b) Trade practices and market organization. The centralization of the produce market has resulted in congestion of motor trucking around these markets.

(c) Fluctuation of receipts. The daily and seasonal fluctuations in receipts creates a problem of unused equipment during periods of small receipts and problems of traffic con-

gestion during periods of large receipts.

(d) Fluctuations of market demand. Heavy buying days in contrast with light buying days also result in problems of unused equipment and traffic congestion.

(e) Physical facilities at truck-loading points. Lack of adequate design of railroad team tracks and other truck-traffic loading points for motor-truck use frequently results in congestion and delay.

(4) Commercial motor trucking is a relatively small part of total motor trucking. On Cook County highways 83 per cent of all trucks are owned by the owner or shipper of the commodity hauled.

(5) Within the commercial-haulage industry a tendency toward concentration is evident. In the Chicago area approximately one-fourth of the firms own three-fourths of the equipment, employ three-fourths of the employees, and receive three-fourths of the gross revenue.

(6) A tendency toward the use of trucks of smaller capacity (3½ tons or less) in place of trucks of 5-ton and larger capacities is apparent. In certain areas the smaller trucks are being equipped with larger bodies.

(7) There is a decided lack of standardization in the commercial trucking business. Few, if any, standard record or shipment forms are used, particularly by the smaller companies. Complete operating-cost records for individual trucks, or even for fleets of trucks, are unknown to most companies. A few of the larger and better organized trucking companies keep cost records, but the cost systems as well as the analysis of costs and the application of the results as a central factor in management can be considerably improved. The creation of a depreciation fund to replace worn-out equipment is practically unknown among the smaller companies.

INVESTIGATIONS OF THE EFFECT OF HIGHWAY IMPROVEMENT ON LAND VALUES

Investigations of the effect of highway improvements upon rural land values are still in progress and final conclusions are not available. It is apparent, however, that there is a relationship between highway improvements and rural land values, and that this relationship is measurable. The effect of highway improvements upon the value of such land varies with several factors, and in general agricultu-

ral areas the variation in value resulting from different types of highway improvement is but a small part of the total farm value. In special-culture areas such as intensive dairy or truck farming sections highway improvements may be expected to have a greater effect upon land values than in general agricultural areas.

IRRIGATION INVESTIGATIONS

The irrigation investigations conducted by the bureau all have for their purpose the promotion of the economical use of water. The need of research of this character has never been greater than it is at present. In the early days of irrigation farming the supply of water was greater than the demand. This condition led naturally to the development of wasteful practices in the use of water which now must be abandoned not only because the demand is now in many sections greater than the supply, but also, in some cases, because the excessive use of water has caused the soil to become water-logged.

The general problem is being attacked from several angles. Naturally the first is the water requirement of the crops to be grown. How much water do they need? What method of irrigation is most favorable to the production of each, and at the same time most economical. At what stages of the growth is the water required and in what volume? Such questions as these we are endeavoring to answer in the studies of water requirements of crops conducted in cooperation with the New Mexico Agricultural Experiment Station and with the department of engineering and the agricultural experiment station of California. The former work has consisted of a study of various field crops and truck. In California the water requirements of alfalfa have been studied at Delhi, and of crops on the delta lands at the mouth of the Sacramento and San Joaquin Rivers. Other studies of the requirements of rice have been made in the Sacramento Valley.

A bulletin on "Water Requirements of the Arable Lands of the Great Basin" is now being printed and a second publication of the series, entitled "Water Requirements of the Arable Lands of the Missouri River Valley," is in course of preparation. The New Mexico Agricultural Experiment Station will publish a report prepared by the bureau on "Net Requirements of Crops for Irrigation Water in the Mesilla Valley, New

Mexico," based on the cooperative studies conducted for the past several years; and the department of engineering of California has already published the results of the cooperative work in that State on cost of water to irrigators.

The object of scientific irrigation is to supply the volume of water required by the particular crop to be irrigated and no more. The volume of water applied, however, and the rate of application should bear a close relation to the water-holding capacity of the soil. Only the water that is held by the soil within reach of the plant roots is of benefit to the crop. Heavy irrigation of soils of low water-holding capacity is uneconomical, because the water quickly sinks into the soil beyond the reach of the plant roots. The immediate object of the studies of water-holding capacity which have been continued during the past year is to determine what relation, if any, exists between the water-holding capacity of various soils under field conditions and the moisture equivalent of the same soils as determined by the centrifuge method in the laboratory. The ultimate purpose is to provide a basis for estimating the water-holding capacity under the field conditions by means of the standard laboratory test on samples of the soil.

A large number of the field studies have been completed and determinations have been made of the moisture equivalent of the soils so studied. These have developed inconsistencies of such prominence as to demand explanation. The relation existing between certain physical properties of the sample, such as its size, and the resulting moisture equivalent as determined in the usual way has been determined and there is now under investigation the relation of the alkaline content of the samples to the moisture equivalent and the effect of leaching alkali soils upon the moisture equivalent. These studies will be continued as time and opportunity afford.

The question frequently arises in connection with the drainage of irrigated lands, as to how much of the water in saturated soil will be removed by drains placed at given depths below the surface. This question includes also the distribution of moisture not removed by drainage. These questions are receiving special field study as time permits.

Prominent among the losses incurred in the use and distribution of water are those resulting from evap-

oration, both from free-water surfaces, such as the surfaces of reservoirs, and from relatively saturated soil. Considerable additional data have been obtained during the past year on evaporation from a free-water surface, particularly at the Fort Collins (Colo.) hydraulic laboratory, and a progress report of this work has been prepared. These investigations are being extended, in cooperation with the Bureau of Reclamation, to include evaporation losses from large bodies of water. For this purpose the East Park Reservoir in California was selected. The natural inflow into the reservoir is very small during June and is easily measurable. During the spring accurate measurements were made of the inflow and of the evaporation loss as determined from the lowering of the elevation of the lake surface, there being no outflow. In addition to measurements of evaporation from the lake, the evaporation from tanks of special design was determined. Meteorological observations were also made, especially as to air movement and temperature. It is hoped to continue these observations next season. Their purpose is to determine the factors of relationship between the loss of water by evaporation from a standard evaporation tank and from a lake, reservoir, canal, or tanks of various sizes, in order that the results of experiments made with tanks may be properly interpreted.

Additional investigations were conducted to determine the evaporation losses from a relatively saturated soil. For this purpose cylindrical tanks about 30 inches in diameter and 2 to 4 feet deep, filled with various soils, were sunk in the ground until the tops were level with the ground surface. By means of a Mariotte bottle the elevation of free water was maintained at a constant distance below the surface of the soil in the tanks. It is expected to continue these investigations another year before attempting to draw conclusions.

A report on seepage losses from California canals and economic means for their prevention is nearing completion. Some time has been spent on similar studies in Texas, and a complete report will probably be made during the coming year.

The foregoing projects all have to do more or less directly with the prevention of water loss. Another group of investigations has been carried on with the object of improving the methods of water measurement by

which the quantities supplied to irrigators are regulated. Studies of current meters have been continued with the object of perfecting the mechanical features of these instruments.

The improved Venturi flume designed by this bureau has been installed at the Fort Collins and Bellvue stations in Colorado under many different conditions for the measurement of quantities of water varying from a few to 200 or 300 second-feet. The wide range of test conditions has been made possible by the enlargement of the Bellvue laboratory.

A recording device is being developed for use with the new Venturi flume by the use of which it will be possible to show at any instant the quantity of water that has passed through the measuring device, and in addition the quantity passing at the time the instrument is read. Some work yet remains to be done in perfecting this instrument.

Some time has been devoted at the Fort Collins laboratory to the calibration of weirs and other measuring devices with the object of determining the limiting conditions under which they can be used satisfactorily in practice. The Colorado work at both stations has been conducted in cooperation with the State agricultural experiment station.

The bureau is also cooperating with the city of Denver in designing various water-measuring devices to be used in connection with the Denver water supply. It is the intention to test the accuracy of these devices when they are installed.

The studies of silt carried in the lower Rio Grande of Texas and in the Colorado River have been continued. In the case of the Colorado River investigations the preliminary investigations have been practically completed and a report is now being prepared giving the results obtained during the past 12 or more years in cooperation with the California Department of Engineering.

Studies of methods to control gravel in small streams in Utah, mentioned in previous reports, have been continued and extended. New structures have been put in between Box Elder County on the north and Iron County on the south and have proved very satisfactory in solving this vexing problem. Although the flood of Utah streams in 1924 was not excessive there was nevertheless a considerable run of gravel. The principle involved in the control of the gravel is that of

checking the rate of flow of water, thereby causing a deposition of a part of the load of débris carried by the stream. Measurements of the quantity of gravel deposited this year are being made and the cost of the control measures adopted will be determined. It is expected in the future to make this project subordinate to the project of utilizing stream flow for irrigation purposes. A complete report of the work is in preparation.

The field work on the flow of water in metal pipes has been completed and the preparation of the report is now under way. Additional tests have been made on the flow of water in flumes and in a short time the field work will be completed and the preparation of a report begun. Some additional tests were made on the flow of water in large concrete pipes at Tulsa, Okla., and Denver, Colo.

In cooperation with the Bureau of the Census and the Bureau of Agricultural Economics, the bureau has collected considerable data in the West on the sale and settlement of land in irrigation enterprises and the cost of farming under irrigation. In connection with the special agricultural census of 1924 and 1925 a questionnaire was prepared jointly by the two bureaus of the Department of Agriculture, and special enumerators were employed to collect the data. This information, together with that previously collected, is the basis upon which there is now being prepared a bulletin on the subject. It is expected to continue and enlarge somewhat upon certain features of this work.

The study of drainage run-off from irrigated lands has been made a major project. This question is of importance in that run-off is the basis for the determination of the required capacity of drains. Conditions on irrigated lands are so varied that an extended investigation appears necessary. The plan provides for the securing of run-off data from drained areas in most of the States of the West. In conjunction with this, information will be secured as to the quantity of water applied, the proportion of the whole area in crops, the structure of the soil and subsoil, meteorological data, and such other features as may have a bearing upon the question. Use will be made, as far as possible, of data obtained by other agencies. The Bureau of Reclamation has a large amount of information on the subject, as have many of the irrigation districts.

Other investigations the result of which will shortly be published include the study of methods of water delivery which was begun in 1923, a study of the operations of mutual water companies, and the study of the drainage of irrigated lands in the Salt River Valley, Ariz., by means of pumping from wells.

The bureau is frequently called upon by other public as well as private agencies to make special investigations and reports. During the past year about 15 per cent of the work in connection with irrigation has been of this character. On account of the necessity of devoting more time to research this advisory work is being gradually curtailed.

Some time has been devoted to assisting in the organization of drainage districts in irrigated sections. Observations have been made of the methods employed for the drainage of irrigated lands and intensive studies of such systems have been made in some cases. Some attention has also been given to the drainage of so-called "alkali lands."

At the request of the Bureau of Reclamation of the Department of the Interior, a report has been made, in cooperation with the soils department of the Oregon Agricultural College, upon the agricultural and economic feasibility of the proposed Vale, Ore., irrigation project.

A report of a similar nature was made on the Jefferson Water Conservancy District in Oregon, at the request of the governor and State engineer of Oregon, the investigation being made in cooperation with the division of soils of the Oregon Agricultural College, and the State engineer. Later the governor requested the Bureau of Reclamation to become a party to the investigation since that bureau might be asked to assist in or take charge of the building of the project if found feasible. Three possible plans were presented as follows: (1) The financing of the project as a water conservancy district under the State laws; (2) the cooperation of the Bureau of Reclamation with the conservancy district to the extent of building the dam and the completion of the reservoir; (3) the building of the entire works by the Bureau of Reclamation.

At the request of the congressional representative of Chouteau County, Mont., an investigation and report was made upon the feasibility of a water supply for domestic and stock-

watering purposes to serve the Lonesome Prairie section of that county.

DRAINAGE INVESTIGATIONS

The investigations of run-off from drained agricultural lands in the humid sections of the United States have been continued. The studies in the vicinity of Cape Girardeau, Mo., consist of obtaining rainfall and run-off data from one small watershed of about 180 acres with rough topography, from three hilly watersheds ranging in size from 10 to 35 square miles, from one flat watershed of about 25 square miles and from the watershed of the main diversion channel of the Little River Drainage District, about 1,200 square miles in area. In addition, gaging stations and slope courses have been maintained on the diversion channel of Little River Drainage District and the St. Francis River floodway near Marked Tree, Ark., for the purpose of determining the resistance to flow in cleared floodways and for different conditions of growth on floodways.

The results of measurements made on the watershed of 180 acres afford information of value in the design of road culverts, hillside diversion ditches and storm-water sewers draining agricultural areas. The data obtained on the larger hill areas are of value in the design of large diversion ditches and floodways and in the design of sedimentation basins and reservoirs for flood control. The run-off and other hydraulic data relating to the roughness coefficient in Kutter's formula for the dredged ditch draining flat land will be of use in the design of ditches with similar watershed characteristics in this and other sections of the country. A progress report of the investigations up to January, 1925, has been distributed. Subsequently additional measurements have been made following a rain of almost 5 inches over the various watersheds. Ordinarily such a rain would have caused excessive floods, but owing to the abnormally dry condition of the watersheds the maximum rate of run-off formerly recorded was exceeded on only one ditch. This storm brought out strikingly the effect of the condition of the watershed on run-off.

A report has also been prepared covering the investigations on the floodway of the Little River Drainage District which shows conclusively the importance of keeping flood ways cleared of growth to prevent an appreciable

reduction in the discharge capacity, furnishes hydraulic data for use in the design of floodways and large dredged ditches, and recommends a new method for computing the combined flow in a channel and floodway based upon a study of equal velocity curves in the channel and adjoining floodway.

The run-off investigations at Urbana, Ill., mentioned in previous annual reports, have been continued. They involve the collection of rainfall and run-off data for 13 watersheds and the determination of the roughness coefficient in Kutter's formula for the channels draining these watersheds. Five additional stations have been established during the past year, three of these on dredged ditches and two on large tile outlets. These stations replace five of the old stations where fairly complete data had been obtained. A progress report on these investigations covering the work up to January, 1925, has been prepared, so that the results might be immediately available to engineers. The report shows conclusively that where ditches are not kept clear of growth a very high resistance to flow obtains which greatly reduces the discharge capacity as compared with that of a cleared ditch, thus indicating that the maintenance of ditches in good condition is an important factor in obtaining efficient drainage. The data obtained will be of use in the redesign of many inadequate drainage ditches throughout Iowa, Illinois, Indiana, and Ohio where the characteristics of the watersheds are similar to those investigated.

Run-off investigations have also been continued at Cleveland, Miss., and a progress report has been prepared covering the results to January, 1925. Rainfall and run-off data are collected here on a watershed consisting of practically flat land and a determination made of the roughness coefficient in Kutter's formula for dredged ditches and for one large natural channel. Two new gaging stations have been added within the past year.

Similar investigations have been started within the past year at McGehee, Ark. Six of the channels on which gaugings are being made are in the Cypress Creek Drainage District. These will permit of a comparison of the rates of run-off obtained in this district with the values given by the run-off curve used in the design of these channels, and which is quite

generally used by practicing engineers who plan drainage improvements, particularly in the Mississippi Delta region.

Ground-water investigations on tiled areas were started in 1925 on the State experimental farms near Stoneville, Miss., and Urbana, Ill. The purpose is to obtain much needed data on the design of tile-drainage systems, such as the proper spacing and depth of tile for different types of soil. The fluctuations of the ground-water level are determined by means of test wells.

The hydraulic-research investigations on the flow of water through concrete box culverts conducted during the past fiscal year in cooperation with the State University of Iowa have been completed. The tests made on several sizes of culverts have led to the development of new discharge formulas for culverts.

Tests were made at the Iowa laboratory on nine different types of current meters to determine the effect of eddies on the various meters. In addition, tests were made to determine the effect of diagonal currents on meters. The Price meters were also tested with each meter tipped upstream and downstream. All meters were tested in four velocities, namely, 1, 2, 3, and 5 feet per second. The results of the tests show that for certain meters the impact on the meter wheels will cause an over registration of 100 per cent. A complete report covering the investigations will be made during the present fiscal year.

In cooperation with the University of Minnesota and the department of drainage and waters of Minnesota the bureau is continuing the investigations of the effect of alkali waters on drain tile at the University Farm, St. Paul, Minn. This laboratory was established July 1, 1921, primarily to facilitate studying the effect of so-called "alkali" water on drain tile made of Portland cement concrete with special reference to the conditions of southwestern and western Minnesota where tile failures in public drains were first noticed early in 1919 and have continued to develop up to the present season. In 1923 the work of the laboratory was broadened to include studies of the action of the peat and muck soil of Minnesota and Wisconsin on concrete drain tile. The work in Wisconsin is being conducted under an informal cooperative agreement with the department of agricultural engineering of the University of Wisconsin.

Combined with the research work a certain amount of routine work is done by the laboratory, consisting of testing drain tile for engineers, manufacturers, and individuals, and examining for alkali soil waters submitted by engineers from areas in which the use of drain tile is contemplated.

Experimental cylinders of many different types of concrete have been exposed to artificial sulphate solutions in the laboratory and to natural waters under various field conditions. These conditions are briefly as follows:

Cylinders have been stored in the laboratory in tap water very low in total salts and compared with others installed in Medicine Lake, Minn., which has a salt content of 4.5 per cent consisting almost entirely of sulphates. Drain tile have been laid in soil containing various percentages of sulphates. In two installations the soil is well drained; a third is along the margin of a slough where the bottom of the tile is continuously wet and the top usually only damp. Drain tile have also been submerged along the margin of Medicine Lake, Minn. Cylinders and drain tile have been installed in peat at four locations in Minnesota and at an equal number of locations in Wisconsin. In some cases the specimens are continuously covered with water, while in others they are merely moist. They are laid at depths varying from 20 inches to 5 or 6 feet.

As yet no complete report has been issued. The following papers have been published covering various phases:

Report of concrete-alkali investigations in Minnesota 1919-20. Published July, 1921, by State of Minnesota, Department of Drainage and Waters.

Laboratory investigations of the influence of curing conditions and various admixtures on the life of concrete stored in sulphate solutions as indicated by physical changes. *Proceedings of American Society for Testing Materials*, Vol. 24, Part II.

Curing conditions of concrete drain tile, a factor of resistance to sulphate waters. *In Concrete*, June, 1924.

Volume change a measure of alkali action. *In Public Roads*, June, 1924.

Among the problems confronting the sugar-cane growers in the region of the Gulf coast of Louisiana are those due to the variable rainfall. Extended periods of excessive rainfall damage the crop with more or less frequency and periods of drought seriously retard the growth at others. As anticipated, the experiments in irrigation now being carried on by the bureau gave gratifying results during the past season with its very scanty rain-

fall, whereas those in connection with drainage were not so conclusive. However, it is only the average results over a period of years that can demonstrate whether a profit may be expected either from a more intensive drainage or from irrigation, and the work started three years ago accordingly has been continued.

The study made at Cocoa, Fla., of the variation of soil moisture in citrus groves has been concluded, and the final report on the investigation has shown that both excess of, and deficiency of moisture occur much oftener and to a greater extent than had hitherto been suspected, and indicate that the amount of moisture present may have an important bearing on the life of the trees.

The studies of erosion from cultivated fields were continued in North Carolina. It was found that the amount of soil removed from the plot where the heaviest erosion occurred during one period of heavy precipitation exceeded 1 pound per square foot of area. Further study is needed before final conclusions are drawn, but it is hoped that these investigations will afford a definite answer to the farmer who wants to know how to vary the spacing of his terraces in order to insure a minimum of erosion with as few terraces as possible.

FARM MECHANICAL INVESTIGATIONS

The large increase in the cost of producing crops, together with a rapidly decreasing supply of farm labor, has accentuated the need of using more power and mechanical equipment in performing farm work.

During the past 75 years the volume of production of the average farm worker has increased about threefold, due chiefly to the substitution of power and machinery for hand methods. Yet, at the present time, the volume of production per worker ranges from about 12 crop-acres per year in some States to 160 or more in others. A significant fact in this connection is that the volume of production in each State is practically in the same ratio as the quantity of machinery and power utilized per worker.

A large proportion of the farms are not yet using efficient methods of production. This is either because of a lack of appreciation of the value of modern machinery, insufficient knowledge of how to use such machinery, or because the equipment has not been

properly designed to meet given conditions.

Since under present conditions power and labor combined represent, on the average, approximately 60 per cent of the total cost of carrying on a farm business, and as these two items are the chief ones over which the farmer can exercise direct control, greater opportunities for reducing the cost of production would appear to exist through increase in the efficient application of power and machinery than by any other means now available.

An analysis of the saving in labor and reduction in production costs that may be obtained by using various types and sizes of farm equipment is now being prepared and will be submitted for publication.

An appraisal of the total amount of power used on farms in the United States, completed during the past year, showed that agriculture uses as much primary power as all manufacturing and public utilities combined. The cost of this power exceeds \$3,000,000,000 annually. Approximately 60 per cent of the power utilized is supplied by work animals; 21 per cent by tractors and motor trucks; 12 per cent by stationary engines; 6 per cent by electrical apparatus and 1 per cent by windmills. About 15 per cent of this power is used for plowing and listing and an equal amount for road hauling; 7.5 per cent is used for farm hauling; 7.5 per cent for threshing; 5 per cent for irrigation and drainage pumping, with a similar amount for fitting ground, planting, seeding, and haying; 5 per cent for harvesting, and about 4 per cent for the pumping of water for domestic purposes.

Serious difficulties are encountered in the efficient use of power for farm work due to the extreme seasonal demands of many of the farm commodities, the diversity of the operations, the small size of the existing power units and the low-load factor or small percentage of the time the power unit is used. As the result of these variables the cost per unit of power utilized on farms is relatively high.

Most of the agricultural machinery now in use has been developed to the point where it not only saves labor but in most cases will do the work considerably better than it can be done by hand methods. However, little scientific study has been devoted to the basic requirements of the operations to be performed or to ascertain whether or not the methods used ac-

comply with the desired results with a minimum of labor and power input. Tests conducted at one of the experiment stations have shown that the power required to cut and elevate silage may be reduced 50 per cent by employing proper speeds and a blower of proper design. What saving could be shown if such a study were applied to the oldest and most used of all farm tools—the plow? The fundamental requirements of this implement are still undetermined; and no satisfactory method of measuring the actual work done by it has been developed. Power for plowing costs the farmers of the United States over half a billion dollars annually. If, therefore, a reduction of only 10 per cent in the draft of the plow could be effected a very considerable reduction in the cost of producing crops would be realized.

A bulletin has been issued summarizing the information now available on the use of power in agriculture which is intended to serve as a basis for further research into the problems of the more efficient use of power by the agricultural industry.

As a step toward the efficient use of implements a study of the problems of tractor farming in California was made during the year in cooperation with the University of California. A larger amount of power per acre is required in California than in any other State and this item of expense is a serious factor in the cost of producing crops. The cost of horse feed is high and horse power is proportionately expensive. However, the types of farming followed in California are especially adapted to the use of tractor power, and as a result more than half of the field power is supplied by this means. Local conditions require extra care on the part of the operator and special contrivances to keep dust from the wearing parts of the tractor, thus presenting mechanical problems that are not ordinarily encountered. A bulletin is in preparation in which it is intended to offer suggestions and instructions to operators on how to care for tractors and obtain satisfactory results in their use, and also to impress upon tractor manufacturers the need for special dust-proof construction in their product.

The design and size of tractors has materially changed in the last few years; hence a revision of Farmers' Bulletin No. 1045, "Laying out Fields for Tractor Plowing," was made in

cooperation with the Bureau of Agricultural Economics.

A recent trend toward the use of high-grade fertilizers has introduced new problems in methods of distribution. In order to study the best form in which to use fertilizer and the most efficient means of distributing definite quantities on the field, a study of the mechanical problems is being conducted at the Arlington Experimental Farm in cooperation with other bureaus of the department. Soon after this project was begun it was realized that the physical condition of the fertilizer was an important factor which must be controlled. Due to the hygroscopicity of the fertilizer, experiments were required to determine the best conditions for handling it. To carry out this phase of the work a wide range of air conditions was required which necessitated the construction of an especially insulated room and the design and installation of air-conditioning apparatus for controlling temperature and humidity. The project is well under way and many interesting facts are being brought to light.

The work of developing and testing cotton-dusting machines and equipment for spreading insecticides to poison the cotton-boll weevil has been continued through the year in cooperation with the Bureau of Entomology, with headquarters at Tullulah, La. Special attention has been given to the design, construction, and testing of improved dusting apparatus for installation in airplanes. Studies have been made of electrical charges imparted to dust particles when delivered from ground machines and airplanes and also of the atomization and width of spread of insecticide dusts delivered from airplanes and different types of ground machines. Further work will be done during the coming year to determine the most efficient manner of flying for cotton dusting.

The investigations, in cooperation with the Bureau of Plant Industry, in connection with the transportation of fruits and vegetables have included a continuation of the study of the effect of body icing, or the placing of ice in direct contact with the lading, in refrigerator cars. Preliminary tests indicated that the efficiency of the floor insulation in cars of the older type is appreciably affected by the water from the melting ice. Further tests with cars of modern type indicate that such cars are less seriously affected, especially when new. The extent to which liability to damage increases with the

length of service of the car has not yet been determined. This work will be conducted during the ensuing year in cooperation with the Interstate Commerce Commission.

To determine to what extent precooling can be effectively employed to replace body icing, a portable plant has been designed and is being constructed. This equipment is capable of precooling carload shipments and will be used at shipping points in connection with the body-icing investigations. The same equipment will be available also for future investigations of the ice-water method of precooling fruits and vegetables which has recently come into use to a limited extent and appears to present important advantages over previous methods in the shipment of certain green vegetables and fruits.

Additional electrical and refrigerating machinery and equipment have been installed at the cold-storage laboratory, Arlington Experimental Farm, under the supervision of this bureau.

Because of the many requests for advice concerning oil burners for house heating, an investigation is being conducted, in cooperation with the Bureau of Home Economics, to obtain first-hand information in regard to the efficiency and operating characteristics of commercial oil burners. To carry on this work a laboratory was fitted up at the Arlington Experimental Farm with four different sizes of boilers of a type in common use in average dwellings. So far 15 makes of burners have been tested to determine the variation in fuel consumption under different operating conditions and to bring out other economic facts. This project has required a large number of tests and will have to be continued into the coming year before a final report on the findings can be made.

Farmers' Bulletins have been prepared to furnish information on the subjects of small concrete structures, rammed-earth buildings, farm plumbing, and farm water supplies, and working drawings have been prepared for special types of farm buildings. The classified list of farm-building plans, prepared jointly with the State colleges of agriculture, has been revised to include bulletins and recently issued drawings.

DISTRIBUTION OF SURPLUS WAR EXPLOSIVES FOR LAND CLEARING

On July 1, 1924, the bureau had 57,092,000 pounds of smokeless powder

and approximately 10,000,000 pounds of sodium nitrate on hand, in magazines at Old Hickory, Tenn., and at Tullytown, Pa. It had previously investigated the problem of making an economical use of these explosives and had developed a formula for a commercial explosive composed largely of the two ingredients. The name "pyrotol" was given this explosive. Bids for the preparation of 100,000,000 pounds of the explosive were received from five bidders and the bid of E. I. DuPont de Nemours & Co. was accepted, but before the contract was signed a fire at the Old Hickory powder plant destroyed about 20,000,000 pounds of the smokeless powder which was to have been made into pyrotol under the contract. This loss decreased the quantity of pyrotol to be manufactured from 100,000,000 pounds to 66,000,000 pounds. However, a contract was finally signed for the preparation of the smaller quantity of pyrotol at the price of \$0.0733 per pound previously submitted.

Immediately upon the signing of the contract on September 8, 1924, the Dupont Co. began the manufacture of pyrotol at three of its plants at Barksdale, Wis., Dupont, Wash., and Gibbstown, N. J. The shipments made from each plant are shown by months in Table 18.

TABLE 18.—*Pyrotol shipments, fiscal year 1925*

Month	From Barksdale	From DuPont	From Gibbs- town
1924	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
August.....			20, 400
September.....	302, 700	212, 550	113, 350
October.....	574, 600	439, 300	150, 350
November.....	1, 060, 700	416, 500	298, 450
December.....	694, 100	777, 300	340, 000
1925			
January.....	243, 100	876, 900	390, 000
February.....	754, 050	676, 700	172, 100
March.....	843, 600	574, 750	53, 350
April.....	1, 064, 250	107, 250	300, 800
May.....	793, 950	256, 450	174, 150
June.....	431, 500	253, 600	235, 000
Total.....	6, 762, 550	4, 591, 300	2, 247, 950

The total production at the three plants for the fiscal year amounted to 14,352,200 pounds; the total shipments as shown in the table were 13,601,800 pounds. The 750,400 pounds in storage on July 1, 1925, were distributed as follows: Barksdale, 335,250

pounds; DuPont, 346,700 pounds, and Gibbstown, 68,450 pounds.

Of the 13,601,800 pounds shipped, 3,127,900 pounds were on Government and highway-construction orders, 10,473,500 pounds were for agricultural use, and 400 pounds were used for experimental purposes. Table 19 shows the distribution by States of the pyrotol used for agricultural purposes.

TABLE 19.—*Distribution of pyrotol for agricultural purposes*

State	Weight	State	Weight
	<i>Pounds</i>		<i>Pounds</i>
Alabama.....	106, 500	Nebraska.....	79, 700
Arkansas.....	8, 850	New Jersey....	2, 600
California.....	64, 000	New York.....	15, 350
Connecticut....	18, 100	N. Carolina....	700, 150
Georgia.....	33, 200	Ohio.....	72, 000
Idaho.....	227, 900	Oregon.....	1, 021, 400
Illinois.....	44, 300	Pennsylvania...	49, 000
Indiana.....	73, 500	S. Carolina....	101, 000
Iowa.....	280, 000	S. Dakota.....	59, 000
Louisiana.....	15, 500	Tennessee.....	67, 600
Maryland.....	9, 000	Texas.....	87, 100
Michigan.....	820, 800	Virginia.....	48, 000
Minnesota.....	1, 947, 300	Washington....	1, 738, 450
Mississippi....	18, 000	W. Virginia....	250
Missouri.....	89, 600	Wisconsin....	2, 468, 500
Montana.....	206, 850		

Pyrotol used by farmers was distributed in cooperation with the State agricultural extension services in all the States listed except California, Connecticut, and Pennsylvania. No charge was made for the explosive ingredients furnished by the Government but the farmers were required to pay for the cost of preparation, the freight, an overhead charge of one-half cent per pound to this bureau, and an equal charge to the State extension service for its expenses in

connection with the distribution. The overhead fund collected by the bureau was used to pay the cost of storing, guarding, and consolidating the surplus war explosives while the fund collected by the States was used for office expenses and for educational and demonstration work in connection with the distribution of the pyrotol.

The pyrotol distributed during the fiscal year 1925 has resulted in a saving to farmers of at least \$890,000. This figure was obtained by comparing the weighted average delivered cost of pyrotol, namely, 8½ cents per pound, with 17 cents per pound, the manufacturer's delivered price on an equivalent quantity of commercial explosive in carload lots. If the usual retail price of commercial explosives had been used, the indicated amount saved would be several million dollars.

The indirect benefits to the farmers are much greater than the mere money saving and are of a permanent character. This cheap explosive has been used by the agricultural extension service to interest farmers in getting rid of stumps and boulders so that the area of cultivated crops per farm can be increased and larger yields per acre obtained. The extension workers have preached individual farm efficiency and have offered this cheap explosive as one means of getting farmers started along this line of improvement. At least 95 per cent of the pyrotol distributed to farmers has been used in removing stumps and stones from cultivated fields and in adding a few acres more of cultivated land to existing farms. It is safe to say that none of it has been used to induce settlement on new or cut-over lands.

REPORT OF THE CHIEF OF THE BUREAU OF AGRICULTURAL ECONOMICS

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF AGRICULTURAL ECONOMICS,
Washington, July 28, 1925.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Agricultural Economics for the fiscal year ended June 30, 1925.

Respectfully,

HENRY C. TAYLOR,
Chief of Bureau.

HON. W. M. JARDINE,
Secretary of Agriculture.

The activities of the Bureau of Agricultural Economics have grown up in response to pressing need for assistance upon the part of large groups of farmers and others confronted with economic problems related to the production and marketing of farm products. While rendering many specific services and disseminating information of current interest and immediate value to farmers in planning their production and marketing programs, the bureau is also expending much effort upon studies of long-time problems which it is hoped may form the basis of wise policies for future agricultural developments.

It is important that the work of the bureau should be conducted in accordance with sound policies. In viewing the question of agricultural policies, there are three standpoints which may be taken in formulating and promulgating programs for agriculture:

(1) The purely agrarian standpoint which views agriculture and agricultural problems and policies entirely from the standpoint of the largest possible returns to agriculture without regard to the other interests of the Nation.

(2) The purely industrial, business, or city point of view which looks upon agriculture as a source of cheap food and raw material without regard to the welfare of the agricultural classes.

(3) The standpoint of the nation as a whole, from which agriculture is viewed as a source of an ample supply of food and raw material at prices which are reasonable to the consumer and at the same time adequate to provide for a satisfactory life on the farm and in the rural community.

Obviously, the Bureau of Agricultural Economics, being an agency of all the people, must take the national point of view, and it is highly desirable that all those engaged in both country and city occupations may come to see the unity of their interests and adopt this viewpoint. Although it is recognized that farmers have the same right as other groups to organize for the purpose of promoting their own interests, and that all possible information and assistance should be given them in meeting their organization problems, it is not the function of this bureau to promote movements which partake of the character of a struggle for an increase in the farmer's share of the national income at the expense of other classes. Neither is it the function of this bureau to align itself against such movements.

The position of the bureau must of necessity be that of positive leadership in service and educational work which accords with the national point of view. This places the bureau in a position where its major functions are those of fact finding, information giving, and service rendering. This edu-

cational and service work points definitely toward more efficient production, more efficient marketing, and the establishment of a satisfactory standard of living on the American farm in the interest of the national welfare.

It is obvious that the policy of the bureau must be to give great care to the accuracy of the facts it presents and to give full publicity to these facts, without discrimination as to their effect upon any particular class. This policy is essential not only because the Bureau of Agricultural Economics as a Government institution must take the national point of view, but because a knowledge of unfavorable conditions is as important as a knowledge of favorable conditions as a basis of planning production and marketing programs.

In carrying forward the work of the bureau the policy has been to work in cooperation with others. Under this policy of cooperation the work of the bureau has been closely coordinated within itself and with that of other related institutions—a policy which has greatly increased the effectiveness of its work. This cooperation has been varied and far-reaching.

(1) In the first place, the closest cooperation exists between the divisions of the bureau. This makes possible the preparation of the Outlook Report, the Report on the Agricultural Situation, Crops and Markets, and various other reports. In the preparation of these reports every division of the bureau contributes its share, and the reports issued represent the combined efforts and knowledge of the bureau as a whole.

(2) Cooperation is maintained between this bureau and all other bureaus of the department. Much is gained through working in close cooperation with bureaus which are dealing with problems that have a bearing upon the work of this bureau. For example, the pathologists of the Bureau of Plant Industry assist this bureau in the practical work of inspecting shipments of fruits and vegetables by training our inspectors to identify plant diseases. This bureau in turn reports back to the Bureau of Plant Industry plant diseases discovered in order that steps may be taken to eradicate them.

(3) The bureau has cooperated continuously with other Government departments in Washington, such as the Department of State, through its Consular Service; the Department of Commerce, through the Bureau of the

Census, the Bureau of Foreign and Domestic Commerce, and the Bureau of Standards; the Department of Interior, particularly with the Reclamation Service, and the Geological Survey; the Post Office Department, through the use of the rural mail carriers in expanding our crop-estimating service; and with the Navy Department, through the use of its high power radio-broadcasting facilities.

(4) Cooperation with State colleges of agriculture, State departments of agriculture, and bureaus of markets is of tremendous assistance to the work of the bureau. Work was carried on during the past year in 47 out of the 48 States under cooperative agreements covering many lines of work. For example, 29 States cooperated in the crop and livestock reporting work of this bureau, and 34 in the food products inspection service. The Bureau of Agricultural Economics is thus enabled to assist in the coordination of the work of many separate agencies to the end that duplication of effort may be eliminated and that information in regard to activities in all States may be made available to all. Through cooperation with State agencies, the Bureau of Agricultural Economics is in position to aid in the more effective study of local problems. It is expected that the passage of the Purnell bill will aid greatly in the study of the farmers' economic problems and further stimulate cooperation between this bureau and the States.

(5) Active cooperation is constantly increasing between this bureau and agricultural interests and business organizations which are interested in agricultural products. The value of the market news service depends very largely upon the cooperation of the railroads and other transportation companies which furnish information on number of cars of products shipped, movements and destinations of products, unload reports, etc., which are necessary to a full knowledge of the distribution of farm products.

(6) Cooperation of constantly growing importance is maintained with departments of foreign governments and with organizations interested in agricultural products in many foreign countries. Cooperative arrangements have been completed this summer with the principal cotton associations of Europe for the use of universal standards for American cotton. This brings to a satisfactory conclusion negotiations which have been pending

for several years. Through cooperation with the British Wool Federation and other wool interests in Europe modifications have been made in the United States wool standards, and negotiations are now under way for a conference between representatives of American and foreign wool interests at which it is believed these standards will be adopted for general use. A representative of this bureau visited the principal seed markets of Europe last year and made arrangements for an exchange of information with regard to production and marketing of seeds. This service is proving very helpful to producers and shippers of seed in America. Much information with regard to production in competing countries and to outlets for agricultural products abroad is received from foreign governments either directly or through other Federal departments. This provides the basis for an intelligent adjustment of American agriculture to world market conditions.

The International Institute of Agriculture at Rome, technically affiliated with the Department of State, actually serves as an arm of the Bureau of Agricultural Economics. Through this institution information is collected by wire and mail from all the leading crop-producing and consuming countries of the world. In exchange the institute is furnished with data regarding the United States prepared by this bureau. Through cooperation with the Department of State the services of 400 consuls have been utilized in collecting information not covered by the International Institute. Information is secured also through the commercial attachés of the Department of Commerce and from other sources.

Cooperation with agencies in foreign fields is maintained and stimulated by the work of the foreign representatives of this bureau. At the present time six members of the staff of this bureau are stationed in Europe. These representatives travel widely, confer with agricultural interests and governmental departments, arrange for the interchange of information, and keep this bureau informed with regard to all agricultural developments in Europe. They make special studies of the particular needs of the European markets and furnish American producers and shippers with information which aids them in adjusting their production and in selecting and packing their products for the foreign markets.

The services of the bureau are represented in the three main lines of work: (1) The crop and livestock estimating and statistical services; (2) the commodity marketing divisions, including the preparation of standards, market news, and improvement of market practices; and (3) the farm organization and management divisions which provide facts upon which production plans may be based for individual farms as well as for agricultural regions.

The growing demand for facts relating to the economic situation in agriculture is shown by the steadily increasing call upon the bureau for information. The four years that have passed since the consolidation of the economic activities of the department have been marked by the constant straining of facilities to keep pace with the increase in requests for facts and services. The reception of this work is convincing evidence that the plan to correlate closely work in farm management, marketing, and crop estimates is fundamentally sound. The policy of laying before farmers, traders, merchants, manufacturers, and consumers the results of surveys, research, and general observations covering both production and distribution to enable them to make the right decisions concerning their operations is believed to be fundamental in the work of this bureau.

In the marketing work of the bureau special effort is made to determine the kinds, quality, and quantity of product which are and which should be offered for sale. In the process of distribution the questions of standardization, packing, assembling, transporting, warehousing, financing, and finally of retailing all call for special studies and services. The magnitude of the industries concerned make it impossible for any individual producer, trader, or manufacturer to keep fully informed concerning developments in all stages of production and distribution. This has resulted in a growing demand for the services of unbiased governmental agencies.

The efforts to aid farmers by improving their production methods through better culture and husbandry have been far-reaching in their results, but good farm management includes more than good culture. Without broad information in regard to general economic conditions, the farmer is not able to meet the changing conditions in domestic and world markets. Hence the need of closely co-

ordinating the facts of national and world production, movements, and prices for the purpose of providing a basis upon which farmers may plan their program of work.

During the third year of its operation the Bureau of Agricultural Economics has made special efforts to coordinate its various activities with the purpose of providing producers of farm products more adequate information for their guidance.

The outstanding example of such coordination of information is presented in the Annual Agricultural Outlook Report, the third of which was issued by the bureau in February, 1925. This report was made possible by bringing together workers in all economic fields, including farm organization, cost of production, crop estimates, world crop and market statistics, price analysis, studies of demand, standardization and inspection, warehousing, farm finance, land utilization, and the like. All available facts that would be useful in planning for efficient production on the farm were carefully considered. The Outlook Reports emphasize the principle that production and marketing are inseparable and that behind orderly marketing lies orderly production. They furnish a concrete example of how economic information may be assembled and used in formulating a national program for agriculture.

The report issued this year was widely appreciated and generally used by the extension agencies and by the agricultural press in giving to farmers the information they need in planning their farm operations for the year. The purpose of the report was better understood, and the report itself was more carefully prepared, due to the added experience which the staff has gained in this type of work. It is recognized that these reports are now an established part of the work of the bureau, and they are looked forward to by all interested groups.

An important development has been the preparation of State and regional outlook reports based on the national report. In a number of instances the bureau assisted the State colleges and other agencies in the preparation of such reports and plans are being made to cooperate with still other States during the coming year.

Since the work in crop estimating, marketing, and farm management has been brought together in the bureau, more cooperation has been secured with States. Extension directors have asked for aid in inaugurating com-

prehensive educational programs on production and marketing.

Prices that products will bring underlie all production programs. Price studies, therefore, have been an important part of the work of the bureau during the past year. The collection of statistics on prices of farm products at the farm and in the markets has been expanded. The relation of prices to varying conditions of supply and demand has been studied in detail.

Closely related to price studies are surveys of costs and of farm incomes. These studies have been continued and expanded for the purpose of measuring more carefully the factors that influence farm costs and farm incomes. The object has been not only to collect specific figures on costs and incomes and to display the methods used by farmers known to be successful at any one time, but also to determine the basic principles underlying successful production.

Crop estimating is the method of approximating changes in production by the use of sample data gathered by selected observers. It is a current service rendered at frequent intervals during the period when facts on production are of greatest value. The census taken at intervals of 5 or 10 years gives a good historical record of production, but is too expensive and slow a method to be used for shorter periods.

Outstanding improvements have been made during recent years in the methods employed in gathering data and in preparing the crop and livestock reports. The plan of utilizing rural mail carriers to distribute and collect schedules, covering acreage in crops, numbers of livestock, on specific farms, and other data, has proved to be one of the greatest forward steps in recent years. The semiannual pig surveys, made through rural carriers, are now an established feature of the work, and the forecasts of market supply have been found to be reliable.

The intentions-to-plant reports now issued on crops other than cotton have demonstrated their value. The extension agencies have come to understand the purpose of these reports and are using them in advising farmers what to plant. Considered in connection with the outlook reports, reports on intentions to plant are of fundamental importance in outlining programs of action for farmers.

Semimonthly cotton reports begun in 1924 by direction of Congress give

more complete information regarding the progress of the cotton crop than has ever before been available. Although there has been some objection on the part of the trade which would indicate that such frequent reports were somewhat disturbing, particularly to the speculative market, the attitude of the more thoughtful merchants who view the subject from the standpoint of the cotton industry as a whole appears to be that it is impossible to get too much good information. It is perhaps too early to appraise fully the value of these reports.

The importance of the Federal crop-reporting service is shown when a report is not quite as expected by the trade. There are a large number of private reporting agencies that seek to anticipate the Government report for the benefit of their patrons. If there were no Government report with which these private reports could be compared, the producer would not be served, since the private reports are conducted for the benefit of the trade customers.

The use of uniform and generally recognized standards is essential to orderly marketing, as it furnishes the basis for sale on description and for price reporting. Up to the present time standards have been recommended by this bureau, either in mandatory or permissive form for the following products: 32 of the most important fruits and vegetables; 8 grains; 7 varieties of hay; cotton; wool; tobacco; butter and eggs; and for a number of classes of livestock and dressed meats.

An outstanding example of the function of a standard in world-wide trade is that of the universal standards for cotton. The American standards were adopted as the basis for universal standards in 1923, and beginning August 1, 1924, became the basis for world-wide trade in American cotton. Although efforts were made in some quarters to return to the use of standards of local origin, the merit and desirability of universal standards had been demonstrated, and the leading cotton associations of the world have subscribed to agreements with the Secretary of Agriculture to buy and sell cotton on the basis of no other standards than the universal standards. This is believed to foreshadow the adoption of uniform standards and practices in world trade for many other agricultural products.

Cooperative organization among farmers has grown rapidly during

recent years, and the collection of facts concerning the growth and experiences of producers' organizations has been continued until the bureau now has the most comprehensive records of cooperative organizations in the world. These include the history and statistics of over 10,000 active organizations, as well as a large volume of facts concerning the early efforts in this form of organization, both successful and otherwise. Through close contact with active organizations information has been obtained concerning methods of operation and the results of various experiences which makes it possible for bureau workers to advise groups of farmers as to the probable difficulties to be met and what methods have been most successfully used in meeting them.

As a service agency the bureau presents to groups of producers who desire to organize the facts derived from historical studies and current conditions. The bureau is not merely presenting theoretical principles but is attacking real problems, utilizing the experience gained by others as a basis for suggesting what had best be done. The specialists of the bureau have made studies of the operation of organizations and reported personally to the directors on suggestions for improved management. Current legal decisions have been explained by legal advisers of the bureau as an aid to the directors of organizations in determining their procedure under the numerous laws which now relate to cooperative organizations.

Through the extension of the United States warehouse act each year more farmers are enabled to store their products and market them to better advantage. Two years ago only 4 products were storable under this law, while now 10 products are storable. Not only can more products be stored but farmers are beginning to rely on the information shown on the warehouse receipts regarding grade and condition of the products. A typical illustration of the value of these receipts from a marketing standpoint comes from a town in Georgia, where, prior to the operation of the licensed warehouse, the farmers knew little of the real value of their product. In the past two years the confidence manifested in the licensed-warehouse receipt showing grade and weight of the products is evidenced by the fact that all the cotton sold by farmers to buyers and mills at this point is sold on the basis of the ware-

house receipts. The wasteful practice of excessive sampling is thus eliminated, and the farmer gets the current market price for the particular grade of cotton which he produces.

From a credit standpoint the licensed-warehouse receipt attained more importance during the past year than ever before. The regard with which these receipts are viewed by bankers in all sections makes it a relatively simple problem to finance the marketing of crops handled through federally licensed warehouses. Since the Federal-warehouse receipt has attained such importance in the field of marketing finance the bureau is throwing additional safeguards around the administration of the act. Not only is it cautious in granting warehousemen licenses in the first place, but it is insisting on a strict observance of the law. In the past year a number of cases involving violations of the law were referred to the Department of Justice for prosecution, and the first conviction for a violation of the warehouse act was recently obtained.

Research in land economics has been emphasized with respect to the use value of land, classification of lands yet to be brought under cultivation, and a study of the methods of development which will result in the proper use of each class of land. The studies of the factors influencing land values will serve as a guide to investors in farm lands and in making long-time credit arrangements. All of this work is directed toward assembling facts to aid in developing Federal and State policies with regard to agriculture.

The problems of farm credit, farm insurance, and farm taxation have assumed added importance as a result of the war and the depression which followed. In the credit studies of the bureau an effort has been made to ascertain the capital, production, and marketing credit needs of farmers, the sources through which needs are supplied, and the terms and conditions under which credit to farmers is advanced. As a result of these studies it has been possible to assist both individual farmers and farm organizations in their credit problems.

Adequate insurance at reasonable cost is essential to safe farming. Greater use of insurance in its various forms will afford needed protection and help stabilize the farm income. Although insurance against fire is obtained by many farmers through joint-stock fire insurance companies,

the studies of the bureau show that farmers' mutual fire insurance companies have been very successful in meeting the fire insurance needs of farmers. The need is great also for insurance covering crop losses, over which the farmer has no control. The bureau has devoted considerable time to the difficult problems in this field.

During recent years farm taxes have increased while the funds from which they are paid have not correspondingly increased. The studies of the bureau during the past year have shown that farmers are carrying a disproportionate part of the tax burden. These studies have indicated ways and means whereby a more equitable distribution of the tax burden may be accomplished.

The livestock industry has been particularly in need of aid during the past year. The service of the bureau to the livestock industry falls into three principal classes. The first covers estimates of supply, market prices of live animals, and measures of their movement to market. Prompt service is the watchword, particularly in the market news quotation service. Though the news service is almost national in scope, there are a few important markets that should be added to the system. The second consists of the standardization of livestock, meat, and wool as a basis for price quotation and grading. The third aims to develop better practices in marketing. Particular attention is being given to the retail distribution of meats and a nation-wide survey was begun to uncover the general facts.

The standards of quality prepared by the bureau for eggs have been revised and presented to the trade during the year. A number of wholesale grades have been adopted as a basis for trading in exchanges and for inspection. To carry the standards back to the egg producers, numerous egg-candling and grading schools have been held in cooperation with extension agencies. Over 20 States are now conducting active egg-grading work for the purpose of educating producers to offer only graded eggs in the primary markets. The market news on eggs and poultry products has been extended somewhat, but the development of a nation-wide quotation service is dependent upon the adoption of more uniform grades in the several markets.

The dairy market reporting and inspection work should be further ex-

panded. Through cooperation with State agencies inspection of butter at point of production is developing. Through such a service the product of over 400 creameries in Minnesota, amounting to over 80,000,000 pounds of butter annually is being inspected and certified. The certificate issued by the inspector has been carried through to the consumer on each package and used as a basis of creating confidence in the quality of the product.

The services of the bureau to the fruit and vegetable industry have been increased mainly in the direction of shipping-point inspection. This service, which is practically self-supporting, has found wide favor, and the use of the Government certificate is steadily increasing. The advantage of careful inspection near point of production in educating producers to know market requirements has been shown definitely. The value of the certificate as a means of facilitating trade and minimizing disputes is one of the chief reasons for the growing popularity of this service.

The inspection work has been conducted primarily through cooperation with the States under nearly 30 separate agreements. The policy has been to adapt the services to the needs of those to be served. Through close cooperation with the trade the work in standardization, inspection, and in improving market practices has been effected without the recourse to mandatory law, exemplifying the advantages of working closely with all interested groups in Government work of this character.

The difficult problem of preparing standards for hay has been successfully met by the workers of this bureau. The great number of varieties and classes of this product, the wide variations in practices in different markets, and the difficulty of preparing exact measurements of quality made the problem extremely complicated. The United States hay standards now cover the principal varieties of hay. Numerous hearings were held with producers and the trade in all the important hay-producing regions in order that the standards as finally adopted might be entirely satisfactory. Hay-inspection service has been extended particularly in the Southeastern and Western States.

Agricultural economics can not give a complete answer to the problem of stabilizing American agriculture without considering the economic aspects

of the farm population. Movements of population to and from farms, standards of living, housing conditions, rural institutions, relations of town and country—all subjects of research growing out of everyday situations of farm people—have an important economic bearing on a stable agriculture.

The farmer and his family are engaged in agriculture as an occupation in order to obtain a satisfactory living. The bureau endeavors to assist farmers in every way to obtain a satisfactory return for their labor and investment through improved methods and practices. It is not enough, however, to help them obtain a satisfactory financial return. The more prosperous they become the greater the danger that they will leave the farm and seek occupations in towns and cities unless they are able to find satisfactory living conditions on the farm and in the rural community. The research in farm community conditions is designed to help keep good farmers on the farms, since it is thought that good farmers will not leave the country for the town if a satisfactory standard of living may be maintained on the farm. The economic problem of farm population, therefore, is a study of all the conditions surrounding the farmer's living in the country to see that all the facilities for a good living may be established in the farm communities.

ORGANIZATION OF THE BUREAU OF AGRICULTURAL ECONOMICS

The principal divisions of the bureau as organized at the close of the fiscal year are as follows:

ADMINISTRATION

HENRY C. TAYLOR, *Chief*.
 LLOYD S. TENNY, *Assistant Chief*.
 NILS A. OLSEN, *Assistant Chief*.
 J. CLYDE MARQUIS, *Director of Economic Information*.
 LOUIS G. MICHAEL, *Foreign Agricultural Economist*.
 C. W. KITCHEN, *Business Manager*.
 F. J. HUGHES, *Employment Manager*.
 H. F. FITTS, *Administrative Assistant*.

PRODUCTION DIVISIONS

Farm Management and Costs.—M. L. WILSON, Senior Economic Analyst, in charge.
 Types of farming.
 Economics of crop production.
 Economics of livestock production.
 Farm records and accounts.
 Production programs.
 Incomes from farming.
Crop and Livestock Estimates.—W. F. CALLANDER, Senior Statistician, in charge.
 Crop Reporting Board.

Crop and Livestock Estimates—Continued.
 Research in statistical methods.
 Livestock reports.
 Crop reporting.
 Price reporting.
 Tabulating and Computing Section.

MARKETING DIVISIONS

Cotton.—A. W. PALMER, Chief Business Specialist, in charge.
 Cotton standardization.
 Classification of cotton.
 Enforcement of cotton futures and cotton standards acts.
 Future and spot market investigations.
 Cotton price quotation service.
 Cotton testing.
 Demonstration of cotton standards.
 Research in cotton marketing.
 Standardization of cottonseed and products.
 Fruits and Vegetables.—W. A. SHERMAN, Chief Marketing Specialist, in charge.
 Market news service.
 Inspection service.
 Grades and standards.
 Standard containers.
 Research in marketing methods and costs.
 Foreign competition and demand.
 Livestock, Meats, and Wool.—C. V. WHALIN, Assistant Chief Business Specialist, in charge.
 Market news service.
 Livestock marketing investigations and market movements.
 Livestock grade standardization and demonstration.
 Purebred livestock marketing investigations and prices.
 Meat marketing investigations.
 Meat grade standardization.
 Meat grading service.
 Market research analysis and cost studies.
 Wool marketing and standardization.
 Foreign competition and demand.
 Operation of Center Market.—C. W. KITCHEN, Superintendent.
 Grain.—H. J. BESLEY, Grain Supervisor, in charge.
 Grain investigations.
 Milling and baking investigations.
 Research laboratory.
 Establishment of grades.
 Rice standardization and investigations.
 Grain sorghums investigations.
 Grain cleaning.
 Bulk handling.
 Methods and costs of marketing grain.
 Federal grain supervision.
 Foreign competition and demand.
 Dairy and Poultry Products.—ROY C. PORTS, Assistant Chief Marketing Specialist, in charge.
 Market news service.
 Dairy inspection service.
 Dairy products investigations.
 Poultry products investigations.
 Research in marketing methods and costs.
 Cold Storage Reports.—WM. BROXTON, Assistant Marketing Specialist.
 Hay, Feed, and Seed.—W. A. WHEELER, Assistant Chief Marketing Specialist, in charge.
 Market news service.
 Hay marketing investigations.
 Feed marketing investigations.
 Seed marketing investigations.
 Hay standardization.
 Hay inspection service.
 Broom corn market investigations.
 Standardization of beans and peas.
 Warehousing.—H. S. YOHE, Chief Marketing Specialist.
 Grain warehousing.
 Wool warehousing.
 Tobacco warehousing.

Warehousing—Continued.
 Cotton and broom corn warehousing.
 Fruits and vegetables warehousing.
 Tobacco standardization.

GENERAL DIVISIONS

Agricultural Finance.—NILS A. OLSEN, Senior Agricultural Economist, in charge.
 Farm credit.
 Farm taxation.
 Farm insurance.
 Statistical and Historical Research.—O. C. STINE, Senior Agricultural Economist, in charge.
 Foreign competition and demand.
 Statistical analyses.
 Market statistics.
 Production statistics.
 Transportation.
 Agricultural history.
 Graphics.
 Agricultural Cooperation.—CHRIS L. CHRISTENSEN, Economic Analyst, in charge.
 Economics of cooperation.
 Accounts and business practices.
 Statistics of cooperation.
 Legal phases of cooperation.
 Farm Population and Rural Life.—C. J. GALPIN, Senior Agriculturist Economist, in charge.
 Farm population statistics.
 Population aspects of rural community buildings.
 Farmers' standard of living.
 Economic Library.—MARY G. LACY, Librarian, in charge.
 Land Economics.—L. C. GRAY, Senior Agricultural Economist, in charge.
 Land resources and utilization.
 Land reclamation.
 Land settlement.
 Land tenure.
 Land values.
 Farm labor.
 Division of Information.—J. C. MARQUIS, Director of Economic Information, in charge.
 Editorial.
 Consumer demand research.
 Periodicals.
 Press service.
 Radio news service.
 Exhibits and motion pictures.

DIVISION OF FARM MANAGEMENT AND COSTS

M. L. WILSON, in charge

H. R. TOLLEY, *Economic Analyst*

Types of Farming, W. J. SPILLMAN; Economics of Crop Production, M. R. COOPER; Economics of Livestock Production, R. H. WILCOX; Farm Records and Accounts, J. B. HUTSON; Production in Areas Around Growing Cities, BURKE H. CRITCHFIELD; Adjustments in Production, M. J. B. EZEKIEL; Incomes from Farming, S. W. MENDUM.

At the beginning of the fiscal year the farm-management and cost-of-production work of the bureau was consolidated, thus bringing into still closer coordination the work which aims to assist farmers in modifying their programs of production in order to obtain a greater return. Profitable systems of farming, the lessons which come from the close study of costs, and the changes necessitated by shift-

ing market demand, are considered more closely in obtaining practical results.

Effort is made to assist farmers in adjusting their programs to meet the changing agricultural conditions. Studies are made of the cost of producing farm products in order to help the farmer in determining the most profitable types of livestock and crops to produce and the most efficient methods to employ in the management and production of crops and livestock.

Studies of local problems are made with a view to making recommendations which will meet peculiar local conditions. Close cooperation is maintained with other divisions which handle land-utilization problems, crop and livestock estimates, and marketing problems, with other bureaus and with State experiment stations and extension divisions.

AGRICULTURAL READJUSTMENTS IN AREAS SURROUNDING GROWING CITIES

Studies of areas around growing cities designed to determine the extent to which farmers are meeting the needs of the local markets and to obtain an economic basis for production and marketing programs were made at Lebanon, Pa.; Roanoke, Va.; Macon, Ga.; Atlantic City, N. J.; Keene, N. H.; and Lima, Ohio.

An economic survey was begun of agriculture in the New Orleans trade area, including Louisiana and the southern half of Mississippi. The study is being made through the cooperation of the Louisiana State University and other local agencies. Marketing and production specialists have been detailed from the extension departments and experiment stations of Louisiana and Mississippi, and a representative of this bureau has been assigned to direct the survey.

In these studies the quantities of foodstuffs consumed in the area are determined, the places where they are produced and how producers in the area are meeting the local demands as to quality, quantity, and season of production. Markets without the area to which surplus products are being shipped are studied to determine how producers within the designated area are meeting those market requirements. Competing producing districts outside of the local area are studied to determine the comparative advantages and to place before the farmer facts in reference to the entire industry to guide him in making his production plans. These several

phases are brought together and the possibility pointed out of increased profits to the farmers through increased production for the local market, through meeting the requirements of outside markets by changes in production and marketing practices and in preparation of products for market.

In the Lebanon, Pa., study, where the sale of whole milk furnishes the major cash income, it was found that producers were not meeting the quality and seasonal requirements of the Philadelphia market and that coordinated efforts by producers in general was needed to bring about readjustments that would result in more satisfactory market conditions.

In a survey covering the farm-trade territory of Roanoke, Va., farmers were advised not to increase their production of milk because the local market for whole milk was entirely supplied and the surplus might have to be sold at a much lower price on a butterfat basis. Poultry raisers were shown that an increase in the local production would probably not materially affect the prices received, because poultry products were now being sold in terminal markets, and that an increase in size of farm flock should prove profitable. Vegetable growers were advised of the quantity or truck crops that could be marketed in Roanoke.

The effect of the construction of hard-surfaced roads and the use of motor trucks in marketing farm products and in changing the producing areas of many products for the Roanoke market was pointed out. In Cheshire County, N. H., farms are being abandoned and agricultural production has been declining for the last two decades. The growing of timber on these abandoned farms and as a part of the regular farm organization was encouraged.

The market for dairy products was analyzed, and the basis for a profitable expansion was pointed out. Poultry producers were supplying only about one-half of the local demand, and an analysis of feed costs and price showed the industry to be sound, and farmers were encouraged to increase the size of their farm flocks. Improvement in roads and the use of motor trucks has extended the market area of vegetable growers to a 40-mile radius and has given commercial vegetable growers who have favorable soil and climatic conditions a greater advantage over the small vegetable grower in supplying the local markets.

LIVESTOCK ECONOMICS

Timely economic studies have been made in regions where postwar conditions have left the livestock industry in a chaotic condition, and in sections where helpful and correct direction can be given to adjustments in livestock production that are continuously taking place, in an effort to meet the changed economic conditions.

Studies in the Appalachian region.—Assistance was extended to the cattlemen of southwestern Virginia who are following the practice of using their pastures for the production of grass-finished beef. Analyses were made by the bureau of the demands and requirements of the markets to which the cattle go, in order to determine just what changes in production methods would produce the kind and quality of product for which there is the greatest demand.

In the Corn Belt, field work was continued with the cattle feeder and hog producer to determine and point out those methods and practices that are most profitable under changing economic conditions. The manuscript for a bulletin entitled "The Cost of Producing Pork in Iowa and Illinois" has been submitted for publication.

Sheep production in North Dakota and Minnesota.—With the transition taking place in eastern North Dakota and northwestern Minnesota from grain production to a diversified system of farming, a study was made of the type of livestock that would supplement grain, bring about a better utilization of labor and feed, a better means of controlling weeds and maintaining soil fertility, as well as a better distribution of income throughout the year. With sweet clover used in the rotation to aid in maintaining fertility and keeping down the weeds, it was found that sheep fitted well into the farm organization, causing little extra cash outlay but bringing a cash income at two periods of the year.

As part of the investigation a general study was made, in cooperation with other divisions of the bureau, of the outlook for the sheep industry for the next several years. The conclusions reached were embodied in the bulletin published in cooperation with Minnesota and North Dakota dealing with the place of the sheep enterprise of the region and the extent to which it would probably pay farmers there to increase their production of sheep and wool.

Range cattle production.—Studies of the cost and methods of producing

range cattle in Colorado and Texas were continued, and reports were issued giving timely material on costs and methods which could be used by ranchers as the basis for future plans.

This department has initiated a study embracing the important range cattle producing areas of the United States. In addition to determining the practices and costs of beef production, the studies are designed to show the comparative advantages and disadvantages of these different types of livestock in the different areas and the probable market demand for them. The data assembled show the present organization of ranches and farms in important producing areas, and the risks resulting from climatic conditions affecting carrying capacity of ranges and yields of cash and feed crops. The study will give information on the extent to which the present system of ranch and general farm organization should be modified to meet inherent weather risks and present and prospective economic conditions.

Ranch-organization, cost-of-production, and farm-practice data were gathered from approximately 300 ranches in the area including southwestern North Dakota, southeastern Montana, northwestern South Dakota, and northeastern Wyoming. Supplementing these ranch data, additional material was obtained showing the present and potential uses of the tillable portions of the land located in areas now used principally for ranching. The influence of homesteading and absentee ownership of land upon the grazing industry was studied, as well as the influence of the taxation and credit situation upon the organization and operation of ranches in the area.

DAIRY PRODUCTION

In cooperation with the Divisions of Statistical and Historical Research and of Dairy and Poultry Products, a general analysis of the economics of the dairy industry was begun. Farm records from Vermont were analyzed to determine under what conditions milk could be produced most economically in that region. Arrangements were completed with Wisconsin for a cooperative study of records from the butter region for the same purpose, and with Virginia for a similar cooperative study in the dairy regions of that State. Material relating to this phase of the economics of milk production is already available for Pennsylvania and New York.

The study of costs and methods in fluid milk production in New York, carried on in cooperation with the New York State College of Agriculture, was continued, and manuscripts for two bulletins were completed during the year. From farm-survey records obtained in 1922, a bulletin was completed showing the factors responsible for differences in the earnings of dairy farms in Chester County, Pa. These findings are applicable to dairy farms in the area from northern Virginia to northern New Jersey.

POULTRY PRODUCTION IN WESTERN WASHINGTON

The bureau cooperated with the Washington State college in a regional study of poultry farming in the Pacific Northwest. The purpose of the survey was to study the outlook for commercial poultry farming in this area in comparison with the situation in competing areas; also to determine and recommend better systems of poultry management for individual farms operating under different sets of conditions. A preliminary report of the study was published by the college in December and was used extensively during the winter and spring in extension and teaching work.

COST OF PRODUCING CORN, WHEAT, OATS, COTTON, AND POTATOES

Study of the cost of producing corn, wheat, oats, cotton, and potatoes was continued along lines similar to those pursued in 1922-23 and the results published in the 1925 June Supplement of Crops and Markets. In a study in 15 selected cotton areas, 777 cost-of-production records were obtained. These have been tabulated and a preliminary report prepared for publication setting forth the cost of producing cotton in widely scattered areas with different degrees of boll weevil infestation. A study of the cost of producing wheat under dry-farming conditions in the Pacific Northwest was completed and a manuscript prepared for publication. Information was obtained on various economic phases of the use of tractors and horses for motive power and on the use of combines and stationary threshing machines.

TOBACCO PRODUCTION IN VIRGINIA

In cooperation with the Virginia Agricultural and Mechanical College and Polytechnic Institute farm rec-

ords for the tobacco areas of Virginia were analyzed and the manuscript for a bulletin prepared showing the principal factors responsible for differences in earnings. Farm practices resulting in economical tobacco production were studied, and specific conclusions drawn as to ways of increasing returns on individual farms. These results are of general application to the tobacco producers of the South Atlantic States.

In addition, a bulletin setting forth ways of increasing profits on the tobacco farms of south central Virginia was published by the Virginia extension service, and a number of farmers agreed to put into operation on their farms the practices recommended. These farms were visited by representatives of this bureau and of the Virginia Polytechnic Institute, and definite recommendations were made for each farm. At the end of the year a statement will be obtained as to the effectiveness of the recommendations in increasing profits.

PEACH PRODUCTION

Near the close of the year an extensive survey of the peach industry in the United States was inaugurated. An enumeration of the number of peach trees, classified by age and variety, in all commercial peach orchards is being made in the bureau. Production costs, methods of handling and shipping, influence of varieties and grades on prices, present and possible markets, competition of peaches from different parts of the country, and other data needed by peach growers in planning their production programs are being obtained.

STUDIES IN SOUTHERN STATES

In cooperation with the Georgia State College of Agriculture the bureau made a study in Sumter County to determine the place of cotton and livestock on the farms of that and adjoining counties where the boll weevil has made cotton production very hazardous. Information was obtained from farmers, railroads, business men, and others, and the data are now being analyzed and will soon be available to the research and extension workers of Georgia and to the producers of the area.

In Mississippi work has been continued in a community of 25 farms in Choctaw County. Study of the combination of enterprises and the methods and practices in production has

been under way on these farms for four years. Recommendations for changes in practice and management are made each year as a result of the study. This work will be of importance not only for its immediate benefits to the farmers involved but also as an experiment and demonstration in farm management extension work.

In Arkansas the principal work has been the keeping of farm and farm household accounts with farmers and farmers' wives, approximately 200 records having been kept during the year. A preliminary report on "Standard Costs in the Production of Arkansas Crops" was distributed, and a number of newspaper articles on farm-management subjects were prepared.

In South Carolina an experiment station bulletin on farm management and cost of production in 1922 on cotton farms in Anderson County was published, and data were collected from the same farms for later years.

In cooperation with the Office of Sugar Investigations of the Bureau of Plant Industry and the Louisiana State Experiment Station a study of sugar-cane production in Louisiana was continued and arrangements made to finish the field work at the end of the present crop year. A report covering the three years of study will then be prepared.

PRACTICAL FARM ECONOMICS

A brief textbook, entitled "Practical Farm Economics," designed for the use of farmers, students, and extensions workers, was prepared and published as Miscellaneous Circular 32. This circular states that in order to make the farm pay the farmer must decide what to produce and how to produce it, what to sell and how to sell it, his success depending upon his making the right decisions on these questions. These questions come up nearly every day in the year, and decisions must be based on a knowledge of principles and facts.

FARM RECORDS AND ACCOUNTS

The object of farm records and accounts work is to assist farmers to plan the organization of their farms and decide upon the methods and practices that will result in the greatest profits. Data are collected, analyzed, and presented in order to help farmers plan desirable long-time combinations

of crops and livestock for a particular area and farm. Such data are further used by farmers in reaching conclusions as to adjustments in long-time plans desirable because of changing conditions and prices. This work was continued in 13 States and new work started in 2 additional States. In all of the States in which the work was continued bulletins have been prepared or are now in the process of preparation showing the results of these studies.

An increasing number of States are using the results of this work in connection with farm management extension activities. In making detailed studies of farms in this way wide variations in requirements and returns are noted on farms with similar resources. Careful analyses reveal the organizations and practices that result in the greatest efficiency. This gives extension workers an opportunity to point out and give the details of the operations of organizations and practices that farmers are using in getting the largest profits.

IMPROVEMENT IN RESEARCH METHODS

Attention was given also to improving the methods and technique used in research. A definite statistical test was made of several different methods of measuring the farmer's return to determine which gave the most satisfactory index of an individual farmer's success. A technical paper was prepared for the Journal of Farm Economics presenting the results of this study and describing in detail the computation of "operator's earnings," which was found to be the most satisfactory measure. Rates to be used in cost-of-production investigations were studied with a view to evolving methods of allocating costs in such a way that the charges made against each enterprise would truly reflect the economic alternatives on the farm.

TYPES OF FARMING

A study of the geographical distribution of types of farming was continued, and data obtained from censuses of 1909 and 1919 for relative crop areas and number of animals per 100 acres of crops were compiled and charted by counties for all States. These data are of value in outlining agricultural programs and are in demand from National and State extension services.

AGRICULTURAL PROGRAMS

A study was begun in cooperation with an experiment station and the extension service of New Jersey toward the development of the economic basis for an agricultural extension program for the State. All available information relating to the trends of production, both in New Jersey and other areas, of the important agricultural commodities of the State is being analyzed to determine the market competition that New Jersey products will probably meet in the coming years. The principal types of farming in the State have been determined, and farm-management studies made in former years are being reanalyzed to determine the types of organization that were giving the best returns with the prices and costs which obtained at the time the studies were made. A number of outstanding farmers in each of the principal areas are being revisited in an effort to determine the types of farming and the methods and practices in production that are giving the best returns under present conditions.

A study of the agricultural situation in the Big Bend country of western Washington was inaugurated in cooperation with the State College of Washington. The object of this study is to develop the economic basis for a program of agricultural production in the area. The experiences and methods of farmers in the area during the past 25 years are being studied and combined with results obtained by the experiment stations located in or near the area to determine the possibilities of producing wheat successfully and the possibilities of supplementing wheat production with other crops and livestock.

FARM ORGANIZATION PLANS

Improved plans of organization were studied for farms in a number of areas where farm-organization and cost-of-production data had been collected in former years. A plan of the organization of hill-land farms in southeastern Ohio was worked out in cooperation with the Ohio State College of Agriculture and is now being published in bulletin form. Similarly an organization plan for 160-acre farms in central Indiana was prepared and is being published in a Farmers' Bulletin, entitled "Successful Farming on 160-Acre Farms in Central Indiana." A plan for a 240-

acre farm in central Indiana is in the course of preparation. As a result of data collected in the spring-wheat region in previous years, improved organization plans were developed for farms in two areas of eastern Montana, which are being widely used by county agents and other extension forces in their efforts to assist the farmers in developing a sound and profitable agriculture.

FARM RETURNS

The collection and compilation of incomes from farms was continued. A return of \$1,205 to the owner-operator for the use of \$17,260 of capital and the labor of the farmer and his family is the average shown by a survey of 15,103 farms for 1924. This return of \$1,205 in 1924 compares with an average return of \$1,020 from 16,183 farms for 1923, and an average return of \$917 from 6,094 farms for 1922.

The return per farm in 1924 includes \$1,024 cash, the excess of cash receipts over cash outlay for operating expenses, and an increase of \$181 in the inventory of crops, livestock, machinery, and farm supplies from January 1, 1924, to January 1, 1925.

In addition, the farm family had food and fuel produced and consumed on the farm, the estimated value of which on 13,700 of the farms reporting this item was \$266, and the use of the dwelling, the rent of which was not reported.

Compared with the reports for 1922 and 1923, both receipts and expenses in 1924 were greater than in 1922 and 1923. The margin between receipts and expenses was greater in 1924. The increase in receipts was due principally to the greater value of crops sold in 1924. Receipts from livestock and livestock products were practically the same in 1924 as in 1923. The average cash outlay for interest on borrowed money and for new buildings and improvements was almost the same in 1924 as in 1923. This does not mean that all farmers were more prosperous in 1924 than in the previous years. The net result varies for different types of farming and for different sections of the country.

The total agricultural income of the United States for each year since 1919 has been computed by the division of statistical and historical research.

DIVISION OF CROP AND LIVESTOCK ESTIMATES

W. F. CALLANDER, *in charge*

Crop Reporting Board, W. F. CALLANDER, chairman; S. A. JONES, secretary; Livestock Reports, C. L. HARLAN; Fruit Reports, J. B. SHEPARD; Research in Statistical Methods, J. A. BECKER; Field Service, C. E. GAGE; Tabulating and Computing Section, F. J. BLAIR; Price Reporting, C. F. SARLE.

The Division of Crop and Livestock Estimates is concerned almost entirely with the annual estimating and forecasting of crop production, including acreage and yield of the various crops, as well as with the estimation of the numbers and production of livestock, or, in other words, the gathering, compiling, and publishing of statistics of the annual agricultural output from year to year. Reporting of farm stocks and prices is also an important part of the work.

The research problems involved are largely of a technical nature. They have to do with the application of practically every phase of statistical science to estimating and forecasting.

The economic importance of the basic data gathered by this division to any program of agricultural adjustment is now realized. The demands for information by individual producers, State extension workers, producers' cooperative associations, and other agencies dealing with agricultural production have increased greatly during the past few years. Many of the demands can not be met, due to the inability of the division, with its limited staff of workers, to expand its activities.

Thirty-nine field offices are now maintained by the division, each in charge of an experienced statistician. In most of the cotton States, as well as in the more important Northern States, an assistant statistician has been appointed. The total personnel of the division now approximates 230 persons, of whom 100 are in Washington and the remainder in the field offices.

VOLUME OF REPORTS

More than 400 different kinds of schedules were mailed out during the past year, the total number of schedules sent out exceeding 8,000,000. The various lists of correspondents in the Washington and field offices now exceed 300,000, and these lists are being constantly augmented. A new list has been developed during the past year for the special use of other economic

divisions of the bureau in obtaining information concerning the cost of production, farm income, population movement, finance, land valuation, etc.

COOPERATION WITH STATE AGENCIES

One of the outstanding features of the work has been the close cooperation which has been effected with many State departments of agriculture, which formerly gathered agricultural statistics independently of the Federal Government. In every State but one, where there is a State agency charged with the gathering of agricultural statistics, the work has been combined with that of the Federal Government, thus avoiding duplication and confusion and increasing the volume and accuracy of the statistics gathered. Cooperative agreements are now in effect in 29 States, three of these being with the agricultural college instead of the State department of agriculture—that is, in Alabama, Indiana, and South Dakota.

COOPERATION WITH CENSUS BUREAU

For nearly four months practically the entire field force of the division was placed at the disposal of the Census Bureau in the taking of the quinquennial census of agriculture for 1924. Thirty-eight of the State agricultural statisticians acted as census supervisors for a large district in their respective States. Although the current work of the division suffered to some extent, the importance of obtaining an accurate census was felt to be of paramount importance. Some assistance was also rendered the census office in Washington in the editing of schedules prior to tabulation. All of the prices which will be used in estimating values for this census were furnished by this division.

NEW METHODS OF ESTIMATING ACREAGE

The past year has witnessed the virtual abolishment of percentage or opinion method of obtaining information concerning acreage and numbers of livestock, and the substitution of estimates based on sample data. In other words, instead of asking the reporters to give their opinion as to the change in acreage from year to year, a large number of farmers in every locality are now asked from time to time to give actual facts as to the acreage in various crops and numbers of livestock on their own farms. Careful studies have been made to deter-

mine the number of farms that are necessary to give an accurate picture of each area, in order that a truly representative sample may be obtained.

In the fall of 1924, 750,000 acreage cards were distributed through the rural carriers to the farmers throughout the United States, on which they were asked to record the acres in their farms, the acres in various crops, pasture, etc. These returns were tabulated, and the ratio of the acreage in each crop to the total acres in the farm and to total acres in crops determined. A similar survey will be made each September, the results of which will be available for the December revisions.

For use in making the preliminary spring estimates of acreage planted the Washington office obtained sample data as early as 1914, and a number of the field offices have used this type of inquiry on important crops since about 1917. In 1925 this type of inquiry was made general for the first time in both the Washington and field offices, and a large number of inquiries were mailed out in the spring. The returns have been so satisfactory that this method will be used hereafter as one of the chief sources of information in estimating the acreage in spring crops.

Field count methods.—Increasing use is being made of mechanical means for estimating acreage, which are entirely independent of other sources of information. This method is commonly called the "field count" method. It consists of counting, from the railroad or automobile, the number of fields in each kind of crop along selected routes from year to year and comparing the number of fields so counted. This has been somewhat refined by the use of the "pole count" method, which consists of the counting of telegraph and telephone poles opposite each kind of crop along roads. This method has been found extremely useful in the prairie States, where the land is level and railroads and automobile roads run through the cropped area.

A still further refinement of the foregoing method has been developed during the past two years by the invention of a "crop meter" for attaching to an automobile. The crop meter has, in addition to the regular mileage record of the ordinary speedometer, a series of 12 dials with push buttons, one for each crop, which records the number of feet of each kind of crop growing along the roads

traveled. Roads are selected which are typical of the entire State and the measurements will be made from year to year and the change in numbers of feet in each kind of crop determined for each locality.

SEMIMONTHLY COTTON REPORTS

The year just closed witnessed the inauguration of semimonthly cotton crop reports. Considerable objection to these reports developed during the past year on the part of some members of the cotton trade on the ground that the frequent reports disturbed the market. On the other hand, representatives of producers' associations were of the opinion that the more frequent reports were valuable and useful in view of the rapid changes which frequently occur in the condition of the crop in the periods between reports when they were issued only once a month. The position taken by the crop-reporting board is that no final decision can be reached with respect to the value or lack of value of these more frequent reports until they have been given a thorough trial. As semimonthly reports are specifically provided for by law, any change in the number or time of issuance will have to be a matter of legislation.

SPECIAL LIVESTOCK REPORTS

The special livestock reporting service is producing practical results. The semiannual hog surveys, from which forecasts of probable marketings the following season, and reports on intention to breed, are made, have been the most outstanding feature of the work thus far. These reports are now looked upon as a reliable indication of the future hog supply. The forecasts of the spring and fall supplies of pigs have proved to be very accurate, and when they are more generally understood by producers should exert an important influence on the number of sows bred from year to year, and should aid in preventing unprofitable swings in hog production. The fifth semiannual report was issued on June 25 of this year. The report issued on July 1, a year ago, which forecast a decrease in the supply of hogs in the spring and summer of 1925, is credited by some as being one of the principal causes of the rather rapid rise in hog prices last summer in the face of unusually heavy receipts.

The survey method of obtaining livestock information has proved so accurate in the forecasting of hog

production that it is now being extended to other classes of livestock, namely, sheep, dairy cattle, beef cattle, and poultry, and it is expected that these surveys will make possible accurate forecasts of the probable marketings of lambs and beef cattle, as well as the number of dairy cattle on farms for one or two years in advance. Information is also gathered on these surveys of the supplies of livestock by age and sex classifications on farms. The splendid cooperation of the Post Office Department, through its rural carrier service, has opened a source of information that it would be practically impossible to use in any other way, except at heavy expense.

INTENTION TO PLANT REPORTS

The intention to plant reports, which were begun in the spring of 1923, have now become a regular part of the division's work. The report for the fall-sown crops is issued about August 15 and for the spring-sown crops about March 15. They are attracting a great deal of attention, and as they become better understood should assist materially in the adjustment of acreage by preventing the overplanting or underplanting of certain crops.

FARM PRICES

The farm prices of crops as of December 1 each year have been collected since 1866, and livestock values as of January 1, since 1867. In January, 1908, the department began to obtain the prices of farm crops monthly, and by 1910 most of the important crops, livestock, and livestock products were included in monthly inquiries. A few additional farm products have been added from time to time until the present list contains some 65 to 70 items, depending on the season of the year.

In March, 1925, the date of the release of the farm price reports was advanced so that they are now issued on or about the 25th of the month to which they relate. This action was taken in response to the urgent demand on the part of economists and business men for the price data at the earliest possible date. Since April 1 it has been possible to publish in *The Agricultural Situation* the farm prices and farm price index numbers a month earlier than formerly.

In March, 1925, the estimated value of farm products was published for the first time on the basis of an annual or

crop year, with weighted farm price rather than the December 1 and January 1 farm values. The annual price is determined by weighting the monthly price by estimated monthly marketings. This is a marked improvement over using prices as of a certain fixed date each year.

In addition to the regular price work as outlined above the division undertook to obtain the census values of farm products for the Census Bureau to use in the quinquennial census now being tabulated. Both crops and livestock values were included on the basis of crop districts. A crop-district price makes county values of production far more reliable than would a general average State price. The prices for 53 separate items were determined. If these same values and price questions had been included on the regular census schedule, it would have increased its size by one-half and undoubtedly would have increased the cost of the census by at least \$500,000.

DIVISION OF COTTON MARKETING

ARTHUR W. PALMER, *in charge*

Preparation and Distribution of Official Cotton Standards, H. C. SLADE; Classification of Cotton, H. C. SLADE; Enforcement of United States Cotton Futures Act and United States Cotton Standards Act, C. L. FINCH; Future and Spot Market Investigations and Cotton Price Quotations, A. M. AGELASTO; Cotton Testing, H. H. WILLIS, E. E. CHANDLER; Demonstration of Cotton Standards, GEORGE BUTTERWORTH, W. I. HOLT; Research in Cotton Marketing, A. B. COX, B. B. SMITH; Cotton Handling Investigations, H. T. CROSBY; Standardization of Cottonseed and Cottonseed Products, G. S. MELOY.

UNIVERSAL STANDARDS FOR COTTON

The establishment of cotton standards which will give the producers, trade, and spinners a common language and a basis of trading, has been one of the major undertakings of the bureau for the past decade. In recent years it has been realized that only by world-wide agreement could the full benefits of this program be realized, while without such agreement there was even little possibility of making effective progress in our own country. In order to secure the adoption of uniform standards for cotton throughout the world a series of conferences was started in Washington during the summer of 1923 between representatives of the Department of Agriculture and of the leading cotton exchanges of Europe which resulted in

the adoption for use abroad of universal standards for grades and colors of American upland cotton.

Numerous conferences have been necessary in order that the standards in force might be modified so as to meet fully the requirements of all parties interested, and that the rules and regulations adopted should be satisfactory to all parties to the agreements. These conferences covered a period of two years and culminated in a meeting held in London May 20, 1925, when a number of amendments to the agreements were adopted with the unanimous approval of the representatives of all the principal cotton associations of Europe. It is believed that all points at issue have been disposed of to the satisfaction of all parties.

In order to assist in establishing the standards in the foreign markets an expert technician familiar with the universal standards has been detailed to this work. His duties are to keep in touch with the holders of the practical forms of the standards, to demonstrate their use, and to answer inquiries concerning them. In this way it has been possible to correct misapprehensions which are detrimental to confidence in the standards. This representative has not only been able to satisfy the trade as to the correctness of the copies of the standards but has also served as a point of contact through which the trade of Europe could readily express its views to this bureau.

INCREASED DEMAND FOR COPIES OF STANDARDS

During the year 7,438 boxes of grades and colors and 1,907 staple types were distributed. This represents a substantial increase over the fiscal year 1924. The domestic price of the boxes of grade and color is \$5 each and that of the staple types \$1 each, both prices being f. o. b. Washington. It was decided during the year to make the prices on those sold to parties outside of the United States landed at destination in order to facilitate distribution. Under this plan the grade standards sell for \$6.25 and the staple standards for \$1.25.

Mention should be made of the issuance of practical forms of the standard of $1\frac{1}{8}$ inch staple length on September 18, 1924; the discontinuance of the standards for sea island cotton on January 22, 1925, owing to the failure of the sea island crop, and

the revision of the standards for grade and color for American Egyptian cotton on July 26, 1924.

Numerous demonstrations of the standards have been made to advantage throughout the year. Classing schools were conducted in cooperation with the Oklahoma Agricultural and Mechanical College, at Stillwater, Okla.; the North Carolina State College of Agriculture and Engineering, at Raleigh, N. C.; Clemson Agricultural College, at Clemson College, S. C.; and the American Cotton Growers Exchange, at Memphis, Tenn.

CLASSIFICATION OF COTTON

In accordance with the United States cotton futures act, all cotton intended for delivery on future contracts is classified by officers of the bureau.

Records were established during the year for total number of annual classifications, classifications handled within a single month, reviews disposed of, and total transfers supervised. The total number of bales classed in the regular and preliminary work amounted to 481,132 for the fiscal year 1925, compared with 288,148 in 1924. A record for classification within one month by a single board was established by the New York board in October, 1924, the figures being 151,379 bales. The prior record was 129,815 bales handled by this same board in December, 1923. The New Orleans board showed the greatest increase in total bales handled during the year. The number of bales originally classified by the latter board during the year was 237,258. This exceeds by 15,034 bales the combined total of the three preceding years. The aggregate reviews for the year were 102,606, as compared with a total of 114,062 for the four previous years combined. The transfer from New Orleans to New York for the year amounted to 65,339 bales, as compared with 3,855 for the previous year, and a total of only 44,896 for the combined five years previous to 1924. In addition to the regular work of the division outlined above, the special committee, appointed by the Secretary to reexamine the certificated stock in New York, reclassified 80,618 bales without the request of certificate holders.

The classification work continued to be self-supporting, and it was found possible to reduce the fee charged for reviews from 30 cents to 20 cents per bale. The volume of cotton classi-

fied since the beginning of the work in 1919 reached 1,629,117 bales on June 30, 1925.

The establishment of a cotton department by the Chicago Board of Trade for trading in contracts for the future delivery of cotton, the delivery points being Houston and Galveston, necessitated the opening of offices in these cities.

CLASSIFICATION OF SPOT COTTON

Section 4 of the United States cotton standards act, which became effective August 1, 1923, provides that any person who has custody of or a financial interest in any cotton may submit the same to the department for classification. The board of cotton examiners at New York and New Orleans which classify cotton tendered for future delivery were designated to perform this service also, and the board previously established in Washington for the purpose continued to hear appeals. Three types of services are offered under this authority, viz, a sample classification, covered by a Form A memorandum; an arbitration classification of the samples of cotton in dispute, stipulated by the parties to be authentic samples, covered by a Form B certificate; and a classification of cotton submitted in the bale and sampled under supervision, covered by a Form C certificate for delivery on futures contracts. During the year, under this provision of the act, 4,441 samples of cotton were classified by the board of cotton examiners at New York and 2,953 samples by the board at New Orleans, all on requests for Form A memoranda. A recent development of this work is the granting of the application of the Savannah Cotton Exchange for the supervision of cotton submitted for classification on requests for Form C certificate.

COOPERATION IN ENFORCING LAW

In enforcing the mandatory provisions of the cotton futures act and the cotton standards act and the regulations under these two statutes every effort has been made to prevent infractions of the law through cooperation with the cotton interests.

The Chicago Board of Trade in the fall of 1924 requested that it be permitted to file with the department for criticism and suggestions a draft of proposed rules relating to cotton transactions. Accordingly a study was made of these proposed rules in view of the requirements of the cotton futures act. Such modifications as it

was found necessary to make were incorporated by the exchange in the final draft of the rules. Various organizations and individuals have repeatedly sought advice on questions involving the applications of one or the other of these acts. In every case the department's interpretation of the law on the matter presented was accepted.

REEXAMINATION OF CERTIFIED COTTON IN NEW YORK

Doubtless the outstanding development in this project was the decision of the Secretary to reexamine the certified cotton in the port of New York. The large stocks which had accumulated there as a result of the heavy October tenders and transfers from New Orleans were not promptly merchandised. It was variously claimed that their continuance in New York exercised a depressing effect upon quotations and that the cause of the failure of this cotton to move further in the channels of trade was due to its inferior quality. The question assumed proportions which seemed to call for extraordinary action, first because of the effect which uncertainty on the point was considered to have upon the entire price structure, and second, because the accuracy of the work of the divisions' classers was placed in doubt.

The Secretary therefore determined to exercise the right reserved to himself in section 6 of regulation 7 of his regulations under the United States cotton futures act, and to re-issue any certificates for which he might find good cause. The department committee reclassified 117,373 bales with special attention to length of staple, and found but 2,620 bales, or 2.2 per cent to be less than seven-eighths inch in length of staple. From these results it is shown that the original work was performed with as great accuracy as is possible under the methods of classification in practice.

LICENSING OF CLASSERS

Authority for the licensing of cotton classers is contained in section 3 of the cotton standards act. Application for licenses were received from 47 persons and licenses have been issued to 11 of these at the close of the year. In order to pass the test the applicant must be a competent judge of cotton and have a thorough understanding of the universal standards.

The purpose of the licensing of classers is to make it possible for producers to obtain a fair classifica-

tion of their cotton by men of recognized competence. The employment of licensed classers by cooperative associations and the trade generally will encourage the full use of the universal standards wherever the trading in American cotton is carried on. Uniformity of classification and the use of a common language with respect to cotton grades and staples should go far toward the elimination of controversies and disputes and thus result in decided economies to all interests and in greater returns to the cotton producer for his products.

MARKET NEWS

Under the cotton price quotation service accurate quotations are secured on sales of spot cotton from as many as possible of the spot markets in the Cotton Belt. These quotations are given the widest possible publicity through published bulletins, by telephone, telegraph, and radio, and through cooperation with newspapers in the South having a combined circulation of over 1,750,000 copies. Branch offices are maintained at Charlotte, Atlanta, Houston, New Orleans, and Memphis, through which information is collected and its dissemination effected. A new feature of this work is the development of systematic reception and posting of radio quotations in the interior markets.

SPOT MARKET INVESTIGATIONS

Under section 8 of the United States cotton futures act the Secretary of Agriculture is authorized and directed to designate not less than five bona fide spot markets, the grade difference quotations of which are averaged for use in the settlement of future contracts negotiated on exchanges located at points that are not bona fide spot markets, when grades other than Middlings are delivered. Ten such markets have been designated, viz, Norfolk, Va.; Augusta, Ga.; Savannah, Ga.; Montgomery, Ala.; Memphis, Tenn.; New Orleans, La.; Little Rock, Ark.; Dallas, Tex.; Houston, Tex.; and Galveston, Tex.

Constant supervision of the different quotations of these markets is required in order that it may be assured that their quotations accurately reflect the commercial value of spot cotton of tenderable grades, since the prices at which future contracts are made are promptly affected by any disparities between actual and quoted values of spot cotton above or below Middling.

COTTON MARKETING STUDIED

The marketing research work has been devoted to three lines of endeavor. The first is the comprehensive study of the underlying economic laws operative in the growing of the crop and its marketing and consumption in this country and abroad. The second phase of the work is the investigation of the methods and practices in primary markets. This investigation was made in cooperation with the Texas Agricultural and Mechanical College. The third phase of the work is carried on in cooperation with the division of statistical and historical research. Analytical studies have been initiated within the past year showing the statistical relationship between the various factors controlling supply, demand, and price of cotton. Attention has been given also to evaluating the relative significance of the numerous types of statistical information utilized by those engaged in cotton production and marketing. Some of the analytical studies which are now in progress are in detail:

Relationship of price during winter to subsequent acreage.

The relation of winter weather conditions to subsequent yield.

The relation of price to (a) production, (b) carry over, (c) price level, (d) cotton movement, (e) consumption, (f) exports, (g) foreign exchange rates.

COTTON HANDLING INVESTIGATIONS

Improvement in the methods or practices in handling cotton between the field and the mill has been one of the major undertakings of the division since its establishment. During the past year the division has undertaken to focus the attention of the whole cotton industry on the magnitude of the annual loss due primarily to obsolete trade practices and careless handling. The assistance of the trade, the cotton producers, and the manufacturers in attacking this problem was assured in an open meeting held at Washington on February 24. Those present volunteered their full cooperation in studies to be made of tare irregularity, gin damage, and means of bale identification.

A thorough investigation of the tare situation brought out the fact that the irregularity in the weight and quality of the bagging used on the American crop causes an annual loss of over \$6,000,000 freight, insurance, overtaring, and patching costs. In addition

to the loss in dollars and cents every marketing transaction is complicated by the irregularity in the weight of tare. As a result of negotiation during the past few months the bagging manufacturers have agreed to accept 2 pounds per yard bagging and 1½-pound ties as the standard and to manufacture only standard-weight materials for stock. The use of 6 yards of 2-pound bagging and 6½-pound ties was adopted as the standard gin tare. It is hoped that with the cooperation of the American Cotton Shippers Association and the trade generally the practice may be adopted of placing a standard light-weight patch on either side of the bale at the time of compression. With the adoption of this latter practice the process of standardizing tare will be well under way.

SPINNING TESTS OF COTTON

Tests have been made during the year of new varieties of cotton which are developed in the Bureau of Plant Industry, of the new official grades which became effective August 1, 1924, and of cotton subjected to various treatments. Spinning tests have also been made on smooth-seeded Pima cotton; five leading varieties of cotton grown in northeastern Texas; three strains of Acala cotton grown at Shafter, Calif.; broad-leaf Acala; okra-leaf Acala; Pima grown at Shafter, Calif.; and Acala and Pima cotton grown at Sacaton, Ariz.

Laboratory tests were conducted in Washington to determine the strength of individual fibers and the percentage of moisture in cotton at various stages of manufacture in connection with the spinning tests. Other laboratory tests were made to determine the strength of the yarn spun from the different cottons. The spinning tests were conducted during the past fiscal year at the Clemson Agricultural College, Clemson College, S. C.

The 100s yard spun from smooth-seeded Pima, while slightly less strong than that from bulk Pima, equalled the new Draper standard, and in case of 120s fell but slightly below the standard. Any yarn that equals or approximates this standard is considered exceptionally strong.

The results of the spinning tests of five leading varieties of Texas cotton and a lot known as "Hoground" showed these cottons to rank as follows: (1) Acala, (2) Lone Star, (3) Mebane, (4) Kasch, (5) Rowden, (6) "Hoground."

The spinning work of the several strains of Acala and Pima from California and Arizona has been completed, and the data are being compiled for office and field station information. Several articles have been prepared for textile journals during the year on the results of the several spinning tests. Various other tests were conducted, usually in response to a need for specific information in regard to conditions in a particular locality. Numerous letters from cotton producers and spinners have been received with requests for the solution of problems which they have met, and assistance is being given wherever possible. Among the tests now under way is one of Egyptian cotton grown from Pima seed, which is being made at the request of the Department of Commerce.

Technical studies were made during the year of the character of fibers and the possibility of measuring mechanically the three qualities—length, strength, and brightness. The value of this work lies in its utility as a means for the more exact preparation of the standards which are distributed for the use of the trade. It is believed that as a result of the progress made in the photometric measurement of brightness the grades can now be given a numerical expression in terms of reproducible objects. The development of a means whereby length and strength of fibers can be measured readily will be of great importance in safeguarding the accuracy and comparability of standards of staple lengths and in establishing standards for staple character. Many of the tests were made in cooperation with the Bureau of Standards.

STANDARDIZATION OF COTTONSEED AND COTTONSEED PRODUCTS

In response to requests made from time to time studies were undertaken within the year to develop standard grades for linters and cottonseed. It has been found possible to divide the range of linters into seven groups or grades, each group containing the variation usually found in a bale of linters prepared under careful management and not greater than the variation acceptable to consumers. These seven grades have been exhibited and explained at numerous public hearings and have met with the approval of the trade. The Secretary's order officially promulgating the standards for linters was signed July 7, 1925, and in accordance with its terms the standards will become effective August 1, 1926.

In the sale of cottonseed, under the present rules of trade, moisture content, foreign matter content, and soundness of seed are used as a basis of grading. It has been found, however, that the consensus of opinion of the oil mills is that the oil content of the seed is the prime factor and the considerations named above of secondary consideration. Several studies have been made in an effort to discover what physical characteristics, if any, may be correlated with oil content so that grading may be done on the basis of such characteristics. Preliminary experiments indicate a possible relation between density and oil content. It is hoped that this problem can be worked out within the ensuing year.

DIVISION OF FRUITS AND VEGETABLES

WELLS A. SHERMAN, *in charge*

Market News Service, EDWIN W. STILLWELL; Inspection Service, F. G. ROBB; Grades and Standards, H. W. SAMSON; Standard Containers, H. A. SPILMAN; Research Studies, H. W. SAMSON.

The Fruit and Vegetable Division is composed of those activities within the bureau which are designed to aid in bringing about better marketing of fruits and vegetables in the United States, chiefly by four methods:

(1) By a better system of standardization. This means the introduction of definite grades as the basis of the wholesale trade in these perishables. Standardization is accomplished by determining the dividing lines between qualities which will separate a fruit or vegetable into distinct grades. These grades should represent different market values. They must also provide for the entire crop, as ordinarily grown. As a basis of trade such grades supply a uniform language for the industry and result in better understandings and fewer disputes between shippers and receivers. They also furnish the only uniform and intelligible basis for price quotations, either at point of origin or at the markets.

(2) By gathering and distributing every kind of pertinent information to aid in the intelligent distribution and profitable disposition of our enormous carlot movement of fruits and vegetables. Market news services include complete daily records of shipments by commodities received by telegram from every originating carrier, reports of arrivals at all principal markets, cars unloaded daily in these markets,

passings at certain important gateways, and much information on diversions from strategic points. This is followed by reports of prices prevailing in typical producing centers and principal markets on most fruits and vegetables, segregated by varieties, types of packages, and States of origin. All of this information is given the widest possible publicity. Every modern means of communication and publication is used.

(3) Through an inspection service which gives effect to the standardization program and brings its meaning and benefit home to the producer by applying the standard at his shipping point. It also protects his interest in the terminal markets by putting within his reach a disinterested certificate of the facts as to the condition and quality of his shipment on arrival. Inspection is furnished on request and for a fee. The service is largely self-supporting and is a direct commercial aid in marketing a specific shipment or in consummating a specific transaction. Trained men are available to examine carefully typical samples of the goods and certify to their quality and condition, usually in terms of established grades. These certificates are the basis of a large and steadily growing volume of business. A quotation on goods "Government certificate attached" inspires confidence. An official certificate of condition may be the best basis for a loss or damage claim against a carrier. It may often be the only acceptable basis for pooling shipments, handled through a single agency.

(4) By continuous study of critical phases of the business as they develop under the changing conditions of production and demand. The relationships existing through the industry are studied with a view to suggesting aids, safeguards, and remedies.

MARKET NEWS SERVICE ON FRUITS AND VEGETABLES (INCLUDING PEANUTS AND HONEY)

Although funds available for carrying on the market news service were the same as during the preceding fiscal year, it has been possible to increase the scope and value of the work by emphasizing certain features. The total number of mimeographed market reports distributed during the year was approximately 10,900,000, an increase of 27 per cent over last year. Much wider use of the press and radio in the dissemination of market information, increased efforts to place economic facts before growers and the

trade in popular form through reviews and summaries, and a general strengthening and tightening of all lines of work indicate definite progress in the market news service.

Local papers in three-fourths of the cities in which the market stations are located publish in full prices on the local market. In addition, in many places shipments and information from other markets are published for the benefit, primarily, of rural readers. Contacts with press associations have been developed and strengthened. For example, from Chicago a special report covering prices and market conditions on southern products is sent on Associated Press wires to 84 papers throughout the South, and a similar report on Michigan products to 28 papers in that State. Press association wires out of Denver and San Francisco carry comprehensive reports on market prices and conditions of interest and value to readers of papers throughout the West. Texas press wires carry reports from Austin and Fort Worth to State papers. The Southeast is served from Atlanta. Philadelphia serves as a distributing point for the Middle Atlantic States, and there are special services from other points.

Very comprehensive radio programs are being built up in many places. Daily reports are sent out from many points and a growing demand for the bureau material is developing. Radio telegraph is used to transmit information to field stations at Laredo, Tex., and Rochester, N. Y. Austin is the relay point for the former and Washington for the latter. Local reviews or modifications of the weekly market review issued at Washington also are broadcast from a number of large stations.

Reviews and statistical summaries of field deals, receipts at markets, price trends, etc., are bringing many commendations. Requests for these reviews and summaries are being received in increasing numbers from educational institutions, research bureaus, cooperative organizations, transportation officials, farm advisory groups, members of the trade, growers, and others. Weekly and monthly reviews seem to be especially well adapted to growers' needs.

PRODUCTS INCLUDED IN MARKET NEWS SERVICE

Telegraphic shipment reports from the carriers at present include 34 products, and complete market reports are

issued on 25 of these products. Daily shipment information is published on the remaining products.

COOPERATION OF TRANSPORTATION LINES

The volume of carload shipments reported by this bureau has increased each year as methods of handling have become improved and systematized. Arrangements for receiving the daily telegraphic reports from one general operating officer on each line, rather than from each division superintendent, are practically completed. By this arrangement approximately \$10,000 is saved each year through the reduction in tolls paid for commercial telegrams. It has been found that the reports in many instances are coming more promptly than before and are generally more accurate. The growing interest of the railroad officials and agents in these reports is evidenced by the large and increasing number of requests made by them for tabulations of shipment information.

MARKET STATIONS OPERATED

During the calendar year 1924, 17 branch offices or market stations were operated. The combined mailing lists at these offices and Washington totaled 41,495 names, an increase of 2,760 over the preceding year. A total of 8,130,980 reports were issued from these stations. In addition, 37 temporary field stations were operated in as many producing sections. These offices distributed more than 2,728,000 mimeographed market reports to 28,360 persons on the mailing lists. Reports on 18 crops were issued and service was given in 24 States.

MARKET REPORTS ON PEANUTS

The market news service on peanuts has been maintained effectively during the year. Quotations have been received covering prices paid for farmers' grade stock and selling prices for shelled and unshelled peanuts, peanut oil, and at times peanut meal or cake.

Weekly telegrams have been received from bureau representatives in 13 important markets. These reports include carlot arrivals, market conditions, and prices. Market conditions and prices of Oriental peanuts, f. o. b. Pacific coast points, and the weekly importations of peanuts and peanut oil at San Francisco and Seattle also are obtained. The entire mailing list of about 1,070 names is served with

these weekly market reports from Washington.

MARKET REPORTS ON HONEY AND BEESWAX

At present about 140 large beekeepers and honey shippers, scattered throughout the country, furnish reports of market prices, conditions of colonies, and honey plants, etc., that are combined for publication in the honey bulletin. Four times a year reports from thousands of beekeepers dealing with yield, condition of bees, etc., are tabulated and published.

Bureau representatives in Boston, New York, Philadelphia, Chicago, Minneapolis, Kansas City, St. Louis, Denver, and San Francisco also wire semimonthly reports of the market conditions and prices of extracted and comb honey and beeswax in their respective cities and import and export statistics are obtained. Honey market reports are issued twice a month from Washington to a mailing list of about 2,400 names.

UNLOAD REPORTS FROM PRINCIPAL MARKETS

Daily reports of the unloads of the following products are obtained in the leading terminal markets: Apples, cabbage, cantaloupes, celery, grapes, grapefruit, lemons, lettuce, onions, oranges, peaches, strawberries, sweet potatoes, tomatoes, watermelons, and potatoes. These reports of unloads of carlot shipments are obtained each day from the railroads and express companies in the several market centers. Similar reports are received from important boat lines. In some cases figures also are obtained regarding less-than-carlot receipts and estimates have been made of fruits and vegetables trucked into a few cities.

The data are of great value because they show the monthly and the annual receipts of various products in large consuming centers as well as the sources of supply. When compared with wholesale prices they are an index of the capacity of these cities to absorb fruits and vegetables with a return of reasonable profit to the producer. The market station representatives who originally collect these data prepare press releases or mimeographed statements for local distribution.

BULLETINS, REVIEWS, AND SPECIAL REPORTS

Two important bulletins on shipments were issued—Statistical Bulletin No. 8, which covers carlot ship-

ments of fruits and melons, and Statistical Bulletin No. 9, giving similar data on vegetables. The figures cover four years, 1920 to 1923, inclusive, and show the annual movement by States, counties, and leading shipping stations. Separate tabulations are included for 35 products.

Current tabulations of market prices and conditions for all the leading markets and shipping points are maintained, and special reviews based largely on these statistics are prepared for publication in Crops and Markets for use in statistical bulletins and in answering inquiries for information.

A number of special reports are prepared with a view to giving information in the most usable form to all classes of users. The Weekly Market Review of Fruits and Vegetables analyzes and compares the market movement and prices of the week. The Weekly Summary of Carlot Shipments summarizes in comparative columns the carlot shipments of principal fruits and vegetables as reported telegraphically by the carriers each day. The Monthly Market Review follows the general plan of the Weekly Market Review. The fruit and vegetable section of the weekly Market-grams shows the latest developments of the preceding seven-day period and describes important changes in market prices and conditions. The weekly and monthly issues of the department's paper Crops and Markets contains several pages of material relating to fruits and vegetables.

RECEIVING-POINT INSPECTIONS

The outstanding feature in connection with receiving-point inspection work during the year was the large increase in peanut inspections, 1,629 cars having been inspected in comparison with 252 during the previous year. This increase was due to two causes: (1) A very unfavorable harvesting season caused a large amount of damage from mold and decay. Such defects are of vital importance to the receiving trade. (2) The members of the Southeastern Peanut Growers' Association have made allowances on the basis of United States grades and inspection.

Inspections of fruits and vegetables were made in 226 terminal markets. Branch offices were located in only 32 cities, inspections at the other points having been made by the inspectors nearest these points. During the year 32,334 inspections were made at terminal markets. This was an increase of

3,051 over the preceding year. In addition, 45,824,180 pounds of fruits and vegetables were inspected for the Navy and the Marine Corps; 1,174,221 pounds for the Munson Lines; 5,989,281 pounds for the United States lines, and lesser quantities for other interests. Many thousands of pounds were rejected on the basis of this inspection; and in other cases the price was adjusted, thus effecting a substantial saving for the Federal Government.

SHIPPING-POINT INSPECTIONS

One of the outstanding services rendered by cooperative Federal-State inspection organizations was the inspection of the citrus shipments of the Florida Citrus Exchange during the first six weeks of the shipping season for the purpose of keeping up the maturity standards and for sales purposes. During the past season the inspection service made maturity tests which enabled the exchange to prevent the shipment of immature fruit and the consequent injury to the market. A total of 6,056 cars of citrus fruit was inspected in this State during the year.

During the winter months approximately 2,500 cars of lettuce were inspected in Imperial Valley. The season was a poor one, but the continued use of the service, notwithstanding the small percentage of cars certified U. S. No. 1 is an indication of an increasing demand on the part of buyers for Government-certified cars. Many shippers are finding that they can sell cars which are slightly under grade at only a small reduction if they support their statements of the quality by the Government certificate.

Cooperative agreements were made with the following States which had not previously worked with the Federal department in shipping-point inspection service: Maryland, Michigan, and Oklahoma. Shipping-point inspection agreements with Alabama and Massachusetts were not renewed for the past year. The principal reasons for not renewing the agreements were peculiar conditions prevailing during the onion-growing season in Massachusetts and change in methods of marketing vegetables in the Mobile section of Alabama.

Of the total of 127,500 cars inspected at shipping points, there were 257 reinspections made at receiving markets, 116 of which sustained the original inspection. All of the above

inspections were made under cooperative agreements with the various States with the exception of those in Iowa and Kansas. In these States shipping-point inspections were made as straight Federal inspections.

INSPECTION STIMULATES USE OF STANDARDS

The third year of shipping-point inspection service has again demonstrated that more progress can be made in obtaining the adoption of recognized standards at shipping point through an efficient inspection service than by any other means available to the department. Without exception, supervising inspectors have reported better knowledge on the part of shippers of established standards and more conscientious effort on their part to comply strictly with the best grading practices. Cooperative organizations have been greatly benefited by the inspection service because of the assistance it has rendered them in dealing fairly with their members without the embarrassment usually experienced by officers of these organizations in obtaining deliveries of uniform quality from their members. Such organizations have also made the Government inspection reports the basis for various pooling systems.

RESEARCH AND STANDARDIZATION WORK

This project is concerned with two main lines of endeavor: (1) The promulgation and promotion of standard grades for fruits and vegetables; (2) research dealing with important problems connected with the marketing of these products.

Standard grades.—During the period under consideration new grades were formulated for eggplant, spinach, grapes packed in sawdust or other material, and shelled runner peanuts. Studies leading to the establishment of grades for eastern grapes, green corn, and English walnuts have been inaugurated.

Investigations made by the project have led to revisions in the grades for cabbage, carrots, celery, citrus fruit, lettuce, northern-grown onions, and fresh tomatoes.

The existing grades for barreled apples were reissued as amendment No. 1 to Service and Regulatory Announcement No. 85. Grades for shelled white Spanish peanuts have been revised and reissued as Department Cir-

cular No. 304. Revisions are contemplated in the standards for asparagus, cauliflower, table grapes (California), juice grapes (California), strawberries, and cannery tomatoes.

Close cooperation with the inspection service has been maintained, especially in the use of standards for shipping-point inspection. In this connection the use of these Federal grades has been advanced substantially by means of grading demonstrations and conferences with growers and the trade.

Research studies.—Particular attention has been directed to the problems connected with the efficient handling, packing, shipping, and marketing of fruits and vegetables, in an effort to reduce heavy losses from faulty methods and to encourage the shipments of only sound, uniformly graded products. The high freight rates, the congestion at terminal markets, and increased cost of handling make it necessary that steps be taken to prevent the shipment of deteriorated and unsalable products. Greater care should be given at the shipping point to such questions as the proper degree of maturity at which to ship, the proper methods of packing and handling to insure against loss, and to the sorting out and keeping at the farm the culls and other low-grade products which demoralize the market, decrease the net return for the whole shipment, and result in waste and loss.

During the year the following bulletins were issued: Department Bulletin No. 1242, Marketing Cabbage; Farmers' Bulletin No. 1423, Preparation of Cabbage for Market; and Department Bulletin No. 1325, Marketing Onions.

A bulletin, Packing Apples in Boxes, is now in press. Manuscripts are being prepared on Marketing Northwestern Boxed Apples, Marketing Barreled Apples, and Marketing Tomatoes. A manuscript on Marketing Lettuce is completed and ready for review.

Preliminary studies have been made of the handling of citrus fruits, western grapes, eastern grapes, cannery tomatoes, and miscellaneous vegetables to obtain information to be used in the preparation of bulletins dealing with the marketing of these products.

Work has been completed on a bulletin on Fruit and Vegetable Auction Companies, outlining the services performed and the methods and costs of marketing through these agencies.

Lectures have been given, articles prepared for trade journals, and mate-

rial prepared for extension activities covering marketing methods. Greater interest and cooperation in this work is being shown than ever before and marked improvements in marketing methods and practices are observed.

Foreign market studies.—A representative is being maintained in Europe for the purpose of studying the marketing of fruits and vegetables, peanuts, and other American farm products in European countries, with the view of improving present export methods and enlarging foreign outlets for American farm products. Investigations have been conducted and reports issued covering (1) market requirements and trade preferences for American-grown products in European markets, (2) the amount of actual and potential competition in these markets from other surplus-producing countries, (3) distribution within the importing countries, (4) relative accuracy of foreign statistics as determined by surveys of areas of production, (5) the practicability for export trade of the grades recommended by the United States Department of Agriculture as determined by studies of the grade and quality of American products arriving in foreign ports. Contacts have been developed through which governmental agencies and the foreign importing trade may be familiarized with the department's plans for the standardization and inspection of farm products.

Miscellaneous marketing studies.—Studies are being made of the extent and the factors involved in the development of sun-scald and slimy soft rot of potatoes in the Hastings section of Florida and in other Atlantic coast producing sections.

Analyses have been made of the distribution of various products, together with unloads of specific commodities in large receiving markets, and carlot shipments of fruits and vegetables by commodities and shipping points. Results of these analyses have been recorded in graphic form, which are very helpful to an understanding of the distribution of these products. Statistical summaries and interpretation of data gathered through the market news service have been prepared.

A study of marketing rejections of northwestern boxed apples has been continued. The data for 1922 have been compiled and reports issued to shippers contributing information to the study. Data for 1923 and 1924 seasons are being obtained and will be compiled during the next fiscal year. These studies are proving to

be helpful to producers and shippers who can not follow their shipments through to the terminal market, but must depend for their guidance upon the reports made to them of the conditions in which their products arrive, and suggestions for changes in the methods which will eliminate causes for rejection.

A study of the sizing practices of packers of barreled apples and size preferences existing among jobbers and the retail trade in several important primary markets has been completed. The results of this investigation have been embodied in a personal report to the Western New York Fruit Growers' Cooperative Packing Association.

ENFORCEMENT OF UNITED STATES STANDARD CONTAINER ACT

The employee in charge of this work completed a field trip to the Pacific coast in which a large number of factories and State officials were visited with regard to the enforcement of the standard container act. The October and April conventions of the National Basket and Fruit Package Manufacturers' Association were attended and discussions by the manufacturers were participated in. Conferences were held with manufacturers and with various agencies with regard to round stave baskets and other containers. A hearing before the consolidated classification committee regarding round stave baskets was attended and a trip was made to Williamson, N. Y., in order to talk with lettuce growers regarding the proposed standard lettuce crate for that State.

A trip was made to the celery sections of Michigan and New York for the purpose of obtaining information as to the sizes of crates and boxes used in shipping celery and the possibility of standardizing these containers. As a result, tentative suggestions have been put out as to standard sizes. An investigation was made also, and information collected regarding all types of crates in use in Florida, and the asparagus section of New Jersey, and the markets in Philadelphia and New York were visited in a study of the sizes of asparagus crates being used in New Jersey.

The testing work of the office has been carried forward on samples submitted by manufacturers of containers coming under the law. In addition, much work has been done on round stave baskets and other forms for

which no legal action has been taken. Manufacturers are showing an increased tendency to consult with this office in making any changes in the dimensions of baskets.

Farmers' Bulletin 1434, Standard Baskets for Fruits and Vegetables, was issued during this year. A circular entitled "Notes on Celery Containers" was prepared and sent out to interested growers. A new list of container manufacturers and jobbers was prepared and sent out in tentative form to the manufacturers for their criticism and correction. The revised list will be issued shortly.

COLLECTION AND DISTRIBUTION 1918 EXCESS WOOL PROFITS

WELLS A. SHERMAN, *in charge*
W. L. EVANS, *assistant*

In the year 1918 in order to obtain the quantity of wool which was needed by the United States Government for war purposes, the handling of the domestic wool clip of that year was governed by regulations issued by the War Industries Board, which fixed the price of wool and limited the profit which might be made by dealers. The powers and functions of the wool division of the War Industries Board were transferred to this bureau by Executive order dated December 31, 1918. Since that time the domestic wool section of this bureau has obtained reports from all dealers, so far as known, comprising 178 distributing center dealers and over 5,000 country dealers.

Bureau audits show that the total excess profits made on the 1918 wool clip amounted to \$1,512,315.61. Of this amount \$754,452.97 has been collected, out of which \$449,141.56 has been placed in the hands of wool growers, \$23,312.07 having been refunded to growers during this fiscal year. Distribution to growers is suspended on \$48,887.38 because paid under protest.

The excess wool profits yet to be collected amount to \$723,418.12. Approximately 90 per cent of this amount is due from only 11 dealers, whose excess profits range from \$10,000 to \$295,000. Twenty-five of the 38 uncollected cases are pending in Federal courts. After several court decisions favorable to the Government two cases were decided against the Government. They have been appealed with a view to obtaining a Supreme Court decision as to the validity of the 1918 wool regulations.

DIVISION OF LIVESTOCK, MEATS, AND WOOL

CHARLES V. WHALIN, *in charge*

Livestock Market News Service, E. W. BAKER; Meat and Wool Market News Service, J. A. BURGESS; Livestock Market Investigations and Market Movements, Methods, and Practices, C. A. BURMEISTER; Livestock Grade Standardization Committee, C. E. GIBBONS, D. J. SLATER, E. W. BAKER, L. B. BURK, and J. S. CAMPBELL; Purebred Livestock Market Investigations and Prices, L. B. BURK; Retail Meat Trade Investigations, Meat Grade Standardization, and Meat Grading Service, W. C. DAVIS; Market Research and Analysis, C. E. GIBBONS; Livestock Grade Demonstrations, J. K. WALLACE; Wool Market Investigations and Wool Standardization, G. T. WILKINGMYRE.

During the fiscal year 1925 the division progressed noticeably along each of its main lines of endeavor—research, demonstration, and market news. This progress consisted in strengthening, elaborating, and perfecting the service largely within the geographical limits which existed a year ago. Realizing that the first essential to either correcting bad situations or improving favorable ones is to get a clear vision of the facts involved in the case, continuous study of fundamental conditions prevailing in the livestock, meat, and wool industries has been conducted. Thirty-five market reporters were on the larger livestock, meat, and wool markets of the country throughout every trading day for the purpose of gathering current facts regarding supplies, movements, demand, and prices of these products. Special investigators have worked in local areas studying problems by gathering every available fact pertaining to them. All this information, together with related information from foreign countries, has been assembled, correlated, and analyzed, and in its entirety provides a graphic picture of the industries as a whole. From this record statisticians obtain their material for working out problems, and economists use it as the basis for their studies.

ALL MODERN MEANS OF NEWS DISSEMINATION USED

Gathering the facts, however, is only the beginning. The next step is to make those facts available to everyone who has use for them. To accomplish this the division has used every modern means of communication. All of the leading press associations, the mails, and commercial telegraph companies daily transmit to the various

parts of the United States and to foreign countries, as well, a mass of market information. Radio has been utilized also, and practically every broadcasting station of consequence in the country broadcasts information on livestock, meat, or wool. The leased telegraph system of the bureau has been utilized to the utmost.

DEMONSTRATION AND SERVICE WORK PROVES POPULAR

The bureau sends men into producing areas to give producers and agricultural leaders actual demonstrations of the results of its investigations and research. This applies particularly to the program of standardization of market classes and grades of livestock, meat, and wool. Intensive study has been given for several years to this subject, and the grades which have been worked out for each of these commodities are now being submitted to all branches of the industry for consideration, and it is hoped ultimate formal adoption.

Demonstrations of cattle and sheep grading have been held in practically every range State as well as at some central markets and in Virginia and West Virginia. Similar demonstrations of meat grading are conducted on a commercial scale in many large cities. Demands for meat-grading service in commercial transactions are increasing at a rapid rate. Wool-grading demonstrations are held at frequent intervals at various points in the wool-producing sections of the country. The purpose of all of these demonstrations is to carry directly to the producer and present in the most graphic way possible the essential facts gathered by extensive research and investigation.

The results of these efforts are apparent. The habit among livestock producers and shippers of shipping all their stock to one or two markets, regardless of conditions prevailing on those markets, has now virtually disappeared. The producer is kept advised regarding conditions not only at one market but at many markets. This enables him to see where his greatest opportunity for profit lies and to ship his stock to the market which offers the greatest advantage.

The dissemination of prompt and accurate market information tends to equalize prices and stabilize the market. Every market now knows what conditions prevail at every other market; consequently the price level at any given point is not likely to re-

main far out of line for any considerable time. Stocks move in response to the news of short supplies and high prices, and the high points are leveled off and the low points quickly filled in. When a surplus is threatened on the Atlantic seaboard, shipments are curtailed or stopped off at middle western points, and production and demand are brought into balance.

RESEARCH AND INVESTIGATIONS

Research is the foundation of service and demonstrations. It serves to bring to light the essential facts needed to solve marketing problems. Although the bureau endeavors to follow a general program which has for its object the study of national problems, it has many calls for the study of problems confined to more limited areas. The research activities include the development of grade standards with standard nomenclature for livestock, meats, and wool, the collection, compilation, and analysis of statistics relating to supplies, movements, prices, and consumption of and demand for these products, and the study of the methods and practices followed in marketing and distributing them.

STANDARD GRADES FOR LIVESTOCK

A standard grade classification for livestock has been used by the bureau since it started its market-reporting service in 1918. During the past seven years it has been subjected to the most complete tests for market-reporting purposes throughout the country and has been refined and modified where needed. It is believed that the classification is now complete in every respect.

At the end of the year two manuscripts have been completed. One is a department bulletin defining the classes, subclasses, and minor subdivisions of market livestock, based on age, weight, and use selections, and is to serve as an introductory bulletin or text for the more complete descriptions of the grades which are to appear in other bulletins. The other manuscript is intended as a department bulletin on the standard market classes and grades of slaughter cattle, and will contain a complete description of each grade of cattle ordinarily sold on the market for slaughter purposes.

CORRELATION BETWEEN LIVESTOCK AND MEAT GRADES

Grade correlation studies were carried on in a limited way in connection

with research studies of the marketing of Virginia cattle, and these were helpful in adding to the fund of information on standardization. Information on the subject also was obtained in connection with statistical studies of State origin of livestock received at Chicago. The basic principles of standardization are founded on the existence of the same qualities in identical grades of the live animal and the dressed product.

MEAT GRADES

In addition to being utilized in reporting meat prices the meat grades are given practical application in commercial transactions where purchases are made on the basis of specifications. Service and regulatory announcements covering the operation of the meat-grading service were prepared for publication. Department Bulletin No. 1246, Market Classes and Grades of Dressed Beef, was issued and Department Circular No. 300, Commercial Cuts of Meat, was revised and reprinted. Manuscripts for the proposed bulletins on Market Classes and Grades of Lambs, Yearlings, and Mutton and Grades of Veal Calf Carcasses have been prepared.

WOOL, MOHAIR, AND YARN

Research studies leading to the establishment of wool grade standards have been carried on for several years. Standards developed were official-gated by the Secretary as the official standards of the United States, effective July 1, 1923. Since that time attention has been given to the correlation of the United States grades with the grades in commercial use in the British wool trade with a view to developing standards which can be used in international trade. The work is being carried on cooperatively with the Bureau of Standards and the Associated Textile Manufacturers in this country and with a committee representing the British Wool Federation in England.

The production of mohair is an important industry in certain sections of the country, and in response to the demand on the part of producers tentative standards have been developed. Arrangements were made with the Pacific Cooperative Wool Growers' Association to grade the mohair assembled in its Portland, Ore., warehouse according to these standards. Approximately 50,000 pounds of mohair were graded to the satisfaction of all concerned. The results have

shown that the tentative standards are practicable, and the next step will be to have them promulgated as official standards.

Preliminary work being done by the Bureau of Standards of the Department of Commerce and several of the large wool manufacturing associations in the development of standards for wool yarns and other products of wool manufacture is based largely on the standards for wool that have been developed by this bureau. During the year a number of lots of wool yarns were submitted to the bureau for examination and analysis, both for the assistance of the associations and for the Federal Specifications Board, which is drawing up specifications for the yarns used by Government departments. The analyses have involved the making of many microscopic measurements, as well as the determination of the grades by visual examination.

WOOL SHRINKAGE AND SCOURING INVESTIGATIONS

One of the important factors in determining the value of raw wool is the percentage of shrinkage which will result in preparing the product for the spinner. There is a wide variation in the degree of shrinkage which will result from scouring wools produced under different conditions and from different breeds of sheep. In order to have available more information on the subject, the division has installed equipment for scouring wool by the commercial soap-and-water method. Some preliminary tests have been made with excellent results. These tests were checked by one of the large scouring establishments co-operating with the bureau and found to be satisfactory.

STATISTICAL RESEARCH

Both the market news service and the investigational work furnish an inexhaustible supply of statistical data. These data are compiled, summarized, and analyzed for immediate publication as current information. Later they serve as a basis for long-time studies of price trends, production, consuming demand, and market movements. They have been particularly useful in preparing the annual outlook reports and the special reports released from time to time on the livestock and meat industries.

In addition to the regular market-reporting service, special statistical studies are conducted at all offices, and from Chicago, Kansas City,

Omaha, and St. Paul weekly statistical reports are issued. These reports are confined largely to movements of stocker and feeder cattle and sheep, except at Chicago, where data pertaining to comparative seasonal movements and prices of all livestock to and from leading markets, segregated in some instances by class, grade, weight, market origin, and State destination, are assembled and published. This information serves as a basis in forecasting future supplies and enables the producer to plan his operations more intelligently and market agencies to render better service.

A number of special statistical studies were made, the results of which were published as special reports and reviews and also used in Yearbook articles. Among these were the following:

- Livestock Market Review for 1924.
- Study of receipts and prices of horses and mules at central markets, incorporated in an article on "Horses and mules."
- Outlook reports on cattle, hogs, and sheep for annual agricultural outlook report for 1925.
- Special report on sheep situation incorporated in press article entitled "Should a cattlemen switch to sheep?"
- Special mimeographed report entitled "The price of wool and the demand for woollen clothing."
- Economic Review of the Livestock Industry in the Western Range States with Special Reference to the Range Program.

MARKETING METHODS AND PRACTICES STUDIED

The study of the methods and practices of marketing livestock, meats, and wool is one of the major research activities of the bureau. There is a great demand for information on this subject, as methods and practices vary in different sections and are subject to change as producers and distributors endeavor to reduce costs and increase efficiency in marketing.

A detailed study of all the problems involved in both production and marketing of beef cattle in southwest Virginia was carried on during the current year in cooperation with the Virginia State Experiment Station. The study included the development of the cattle industry in Virginia, present methods, practices, and costs involved in production and marketing, and the extent to which the beef produced met trade and consumer demands. Complete data were obtained on 52 shipments of steers finished in southwest Virginia and followed through the market, slaughterhouse, and wholesale cooler. Data also were

obtained on 17 shipments of fed steers from northern Virginia and the Shenandoah Valley. Complete records were obtained on the methods of handling and feeding these cattle for market. After arrival at market data were obtained on methods of handling, shrinkage, fill, market and shipping costs, dressing percentage, selling price, and grade, both in the live animal and the dressed product. Special attention was given to the quality of the beef produced and its comparison with beef from other sections in meeting trade demands. In cooperation with the Bureau of Home Economics tests were made to determine the cooking and eating qualities of Virginia beef in comparison with other beef.

A survey of livestock marketing methods and problems also was made in five of the Corn Belt States. Special attention was given to cooperative livestock marketing, including local shipping associations and cooperative selling agencies at the central markets and to direct shipping of hogs to packers.

A nation-wide study of the methods and practices of retailing meats was carried on during the year as part of a general study of retail meat distribution and its problems. Field studies were made in 20 cities and towns located in all sections of the country and included 1,404 retail stores handling meats. Two preliminary reports summarizing the results of this study were released as mimeographed documents, entitled "Influences of Methods and Costs of Retailing and Consumers' Habits upon the Market for Meat." Studies in connection with requirements of English bacon trade were made at several packing centers to determine the probability of increasing demand in England for Wiltshires and other English cuts.

PRICES OF PUREBRED STOCK

A survey was conducted to ascertain the prices paid for purebred livestock. Schedules were sent to 15,000 breeders with the request that they report on the number of purebred animals sold at auction and private sales according to breed, sex, and age, and state the maximum, minimum, and average price received for each group. The data obtained were tabulated and summarized for publication, the final report including prices on 24 breeds with each breed segregated into six age groups. It is believed that this price summary represents a reliable

index of existing market values of purebred animals.

MARKET NEWS SERVICE

The number and scope of the market reports issued during the year showed a notable increase. This increased dissemination of the market information gathered was brought about largely in two ways: (1) By increasing the number of special reports put out, and (2) by utilizing to a greater extent than heretofore such primary distributing agencies as press associations, country newspapers, and banks. The regular list of daily, weekly, and monthly reports were continued, and in addition several of the offices put out a weekly statistical report devoted largely to showing movements of stocker and feeder animals segregated by species, State destinations, and weights.

In addition to the above routine practically every branch office began to supply some new and special report to certain publicity agencies. To illustrate, the Chicago office made arrangements with the Western Newspaper Union to supply that organization with a special weekly review of the Chicago livestock market. The Western Newspaper Union furnishes a plate and mat service to the great number of smaller newspapers, daily, weekly, and monthly, scattered throughout the central portion of the United States. Throughout the year an earnest effort was made to hold the number of mimeographed reports issued to a minimum consistent with maximum service and to obtain greater publicity through other means.

Several of the offices are supplying large numbers of country banks with special weekly livestock market reviews. In practically all instances the banks post the reports in prominent places, where they are consulted by great numbers of patrons of the bank and others who visit the bank for the specific purpose of reading the reports. In all such cases the object was to distribute the market information to individuals and agencies which were willing to redisseminate it to still larger groups.

Marketing of the California lamb crop.—The production and marketing of early spring lambs in California has recently become a subject of economic importance. In response to the demand for more information, the bureau inaugurated a series of special California spring lamb reports. The Middle West and East wanted informa-

tion regarding potential supplies, loadings, and movements of California lambs. California growers, on the other hand, needed information regarding supplies, demand, and prices prevailing at Middle West and Atlantic coast markets. Hence the California offices at Los Angeles and San Francisco issued daily reports estimating the crop of lambs to be marketed and later on showing the numbers both live and dressed, loaded in California for shipment east. The meat-reporting offices at Boston, New York, and Philadelphia issued daily reports regarding receipts, demand, tone of market, and prices prevailing for California lambs at those centers and these reports in turn were transmitted to the Pacific coast for the benefit of growers and others interested in such information. During six weeks in the spring of the year approximately 300,000 spring lambs were shipped east from California.

DEMONSTRATION AND SERVICE

Educational work through demonstrations and extension methods, and service which has for its object the development of more efficient marketing and distribution of livestock and animal products have become important features of the general program of activity of the bureau. In certain respects the market news service constitutes a most outstanding demonstrational activity. This news service involves the use of standard forms, standard class and grade schedules, and standard terminology. These reports go out to all parts of the country and are read and heard by thousands of people. The effect has been to popularize the use of uniform standards and uniform terms.

The service work consisted largely of grading meats tendered on contracts or entering into a business deal in which a certificate of quality or grade was essential for the satisfactory settlement thereof.

Livestock grade demonstrations.—Educational work in livestock grade standardization through grade demonstrations became a leading feature of the work in the preceding year because of the increasing interest in standardization on the part of the livestock industry. No work ever attempted by the division was so well received or produced more gratifying results than these demonstrations.

Grade demonstrations were conducted in cooperation with the Federal

and State agricultural extension service in South Dakota, Wyoming, Colorado, New Mexico, Utah, and Nevada and with the State division of markets in Virginia. The demonstrations were held on selected ranches and farms, and at agricultural colleges, and central points where herds and flocks were available and where it was convenient for stockmen, students, and others interested to assemble and observe the actual sorting and grading of the animals.

The object of these demonstrations was to point out to producers the different classes and grades found in their herds conforming to the standard market classes and grades recognized by the department and to call to their attention the difference in quality, conformation, and finish which are the factors which determine grade and the market value of the animal.

The work in the six range States included 86 grading demonstrations with cattle and sheep and 26 addresses on livestock marketing and grading, with a total attendance of more than 3,500 interested persons. Approximately a dozen demonstrations were held in Virginia and one in Baltimore in connection with the Shenandoah Valley livestock market improvement tour. More than 500 people attended the latter alone.

Meetings were held at which special emphasis was given to more efficient marketing by utilizing available market information, discouraging bulk selling, and encouraging grading and sorting in uniform lots according to market requirements, and eliminating alternate gluts and shortages through more orderly distribution of receipts.

Improving the quality of eastern lambs.—The campaign inaugurated to improve and standardize the quality of eastern lambs and bring about their more orderly marketing was continued during the year. The division also prepared for the use of extension workers a mimeographed document entitled "Improving the Market for Eastern and Southern Lambs," which summarizes the results of the three years' program.

Getting the trade interests at Jersey City to give more attention to sorting and buying and selling lambs according to grade rather than in bulk, as heretofore, has been one of the most constructive achievements of this campaign.

Demonstration and extension in wool grading.—Extension work in wool grading was continued. Grading schools were

held at Columbus, Ohio, West Lafayette, Ind., and Salt Lake City, Utah, in cooperation with the State and Federal extension service for the benefit of livestock specialists, instructors in agriculture, extension workers, wool producers, and others. The course consisted of lectures and numerous grading tests and demonstrations with the official standards. One county agent in Utah who attended the course given at Salt Lake City held four demonstrations in his own county afterwards and reported great interest on the part of the 139 sheepmen present. Grading of wool assembled by the Virginia Co-operative Wool Growers' Association was supervised and assistance given to other States where possible.

A representative of the division delivered addresses on wool standardization and wool marketing before annual meetings of the Idaho Wool Growers' Association, Oregon Wool Growers' Association, Washington Wool Growers' Association, National Wool Growers' Association, and the National Association of Worsted and Woolen Yarns Spinners. An article on wool standardization was prepared for the Textile World, and a paper on the same subject was read at the Pan American Conference on Standardization held at Lima, Peru. The distribution of the practical forms of the official wool standards was continued during the preceding year.

Meat grading service.—The meat grading service developed in response to requests from the United States Shipping Board for assistance in solving its problems of buying satisfactory meats for the steamship lines and fleets under its control. The service was extended to the Pacific Mail Steamship Co. and laid-up fleet of the Shipping Board at San Francisco, and to Childs' restaurants in Chicago, Ill., and Baltimore, Md. Practically all important steamship lines operating out of New York are now using the service. Many commercial concerns also make use of it in their daily purchases and sales of carloads of meat.

Assistance was rendered to officials of Pennsylvania State institutions in obtaining uniformity of quality of meats and meat products purchased on the bureau's specifications by actual grading of meats shipped to the institutions on contracts. In this connection meat-grading demonstrations were given at Philadelphia for the benefit of superintendents and stewards of these institutions.

OPERATION OF CENTER MARKET

C. W. KITCHEN, *Superintendent*

Administration, C. H. WALLEIGH; Mechanical Section, S. R. MULLEN; Cold Storage, W. J. CAPNER; Inspection, G. A. ANTHONY

Operation of Center Market, Washington, D. C., was undertaken April 1, 1922, pursuant to an act of Congress approved March 4, 1921. The entire management and operation of this market was transferred to the Department of Agriculture, and the work is being carried on as a project of the Bureau of Agricultural Economics.

In addition to large wholesale and retail markets, a refrigeration plant and a cold-storage warehouse are operated.

GRAIN DIVISION

H. J. BESLEY, *in charge*

Grain Investigations, E. G. BOERNER; Milling and Baking Investigations, J. H. SHOLLENBERGER; Research Laboratory, D. A. COLEMAN; Establishment of Grades, J. H. COX; Grain Cleaning, R. H. BLACK; Bulk Handling, E. N. BATES; Grain Sorghums Investigations, B. E. ROTHEB; Rice Investigations, W. D. SMITH; Federal Grain Supervision, E. J. MURPHY and G. W. MORRISON, Washington, D. C., and R. T. MILES, general field headquarters, Chicago; chairman Board of Review, O. F. PHILLIPS; Inspection Efficiency, F. G. SMITH; in charge Pacific coast headquarters, Portland, Oreg., B. W. WHITLOCK.

The work of the Grain Division consists of two main subdivisions. The first covers research work in the marketing, handling, storing, transportation, and distribution of grain, including the preparation of standards. The second includes the enforcement of the mandatory provisions of the United States grain standards act and the service work incidental to carrying out of the act.

NEW STANDARDS PROMULGATED

Investigations of certain demands made by the grain trade resulted in the promulgation and establishment, effective September 1, 1925, of official standards for feed oats and mixed feed oats, and in the revision of the official standards for oats. Material progress was made in investigations leading up to the establishment of official standards for barley, flax, rough rice, brown rice, and milled rice. A simple test was developed for determining the oil content of flaxseed, and it is planned to demonstrate the test

to the oil trade in the near future. This test reduces the time required to determine the percentage of oil in flax from approximately 24 hours to 7 minutes.

PROTEIN STUDIES MADE

Owing to the fact that protein content has, during the past few years, greatly influenced the market value of wheat, a survey was made of this situation. A detailed study was made of the influence of variations in each of the factors and steps involved in protein testing. The results of this study were recorded in a professional paper entitled "A study of methods for making protein tests on wheat," which appeared in the May, 1925, issue of the Journal of Cereal Chemistry.

Studies were made relative to the proper technique for determining the ash content of flour. These results have been written up for early publication. A chemical test for color in oats was developed. This will be of practical use in the grading of oats of certain types.

Cooperation was given the office of cereal investigations by the research laboratory of this project to the extent of providing facilities for the making of 10,000 protein tests. Similar courtesies were extended to the flax section of that office in the matter of making oil tests on special flaxseed samples for the purpose of developing new and better high oil-bearing varieties.

A large number of chemical analyses were made in connection with the study of what constitutes quality in wheat gluten. Owing to the many factors which enter into the composition of gluten, this is a very difficult subject, and to date no definite explanation of gluten quality is possible. Work has been done in the study of hydrogen-ion concentration of flour, dough, and bread, for the purpose of determining if any relationship exists between this factor and the bread-making quality of flour.

METHODS OF BAKING HARD WHEAT FLOUR

This bureau, together with the Bureau of Chemistry and the Bureau of Home Economics, has been cooperating with a committee of the American Association of Cereal Chemists in an attempt to standardize experimental baking methods on hard wheat flour. Progress has been made in standard-

izing the equipment used in testing and in outlining the investigations needed in the methods of handling.

BAKING DEMONSTRATIONS

Assistance was given the Pennsylvania Bureau of Markets in conducting baking demonstrations at various public institutions throughout the State. The object of these demonstrations was to popularize the use of soft red winter wheat by teaching the proper methods for use in baking bread from soft wheat flour and soft and hard wheat flour blends. The State is primarily interested in this work because it produces soft winter wheat, and although it consumes the flour equivalent of almost twice as much wheat as it raises its wheat product is so unpopular among its own people that approximately one-half of it is sold for export.

BAKING, MILLING, AND CHEMICAL TESTS CONTINUED

Experiments and investigation in regard to the particular formula and method of baking best suited for each of the commercial types of flour were continued and definite progress was made. The data from milling, baking, and chemical tests performed on approximately 1,200 hard red spring wheat samples are being correlated in order to study the relationship and interrelationship of kernel texture, test weight per bushel, and protein content to milling yield, ash content of flour, volume and weight of loaf, color and texture of bread, and water absorption of flour. In making these studies both the gross and net correlation coefficients are being worked out.

A study was made of the causes of "sick wheat" and milling, baking, and chemical tests were performed on 100 or more samples of this type of damaged wheat to determine to what extent the quality of such wheats was affected.

Approximately 1,200 wheat samples were milled, baked, and analyzed for moisture and ash contents of flour and protein content of wheat, more than 1,000 flax samples were milled and tested for oil content, and numerous tests were made for estimating the number of smut spores in smutty wheat. About 400 of the wheat samples tested were furnished by the Office of Cereal Investigations in connection with its work of breeding and

developing varieties of wheat with better milling and baking qualities.

NEW METHODS OF GRAIN CLEANING

A study was made of the processes of removing smut from threshed wheat grown in the Pacific coast region, and a detailed report was issued covering the effect of washing on the grade, test weight per bushel, and market value of wheat, and the actual cost of the smutting operation. Illustrated talks were given and demonstrations were made at farmers', and grain and rice dealers' meetings of improved methods of cleaning and handling of grain and rice.

An improved method was developed for removing so-called "inseparable foreign seeds" from wheat and rye. A device for use in connection with the method was developed in cooperation with a manufacturing concern and is now in use by the department and grain inspection departments.

Two new and improved types of portable cleaning machines were developed for the removal of foreign material from grain either at the threshing machine or at the farm granary. Experiments with both types of cleaner in actual commercial operation demonstrated that each is entirely practical in operation. An aspirator for cleaning grain was developed for use on threshing machines and combines, and a laboratory-sized cleaner was also devised for use in cleaning and analyzing samples in the laboratory. A device for removing the hulls from rough rice, for use as a laboratory device in grading rough rice, was originated, and an improved grain sieve has been developed for removing wild oats from barley and water grass from rough rice.

UNITED STATES GRAIN STANDARDS ACT

Standards for shelled corn, wheat, oats, and rye were in effect during the entire fiscal year. Minor changes in the corn, oats, and rye standards became effective during the current year, as well as more important changes in the standards for wheat. Official standards for grain sorghums were promulgated to become effective December 1, 1924.

Attention has been given to the merchandising of oats, not only under the official standards but by trade name and private brand. The oats standards require that grain must contain at least 75 per cent cultivated

oats in order to be classified as oats. There are on the market, however, quantities of grain mixtures consisting principally of cultivated and wild oats with varying percentages of other grains which do not come within the minimum requirements of the present oat standards. These products have a commercial and feeding value and are in demand not only in certain parts of this country but also in foreign trade. By reason of the fact that no official standards were available for this character of feed, the merchandising has been conducted on the basis of general or indefinite terms, resulting in many instances in confusion and misunderstandings. After public hearings on the subject with members of the grain trade in several markets throughout the country it was decided to promulgate under the grain standards act standards for grain of this kind in addition to the present standards for oats. Accordingly, official grain standards for feed oats and mixed-feed oats were promulgated to become effective September 1, 1925.

LICENSED INSPECTORS AND INSPECTION POINTS

At the beginning of the fiscal year there were outstanding 449 active licenses and, in addition, 30 were being held in suspension. During the year 244 new licenses were issued and 46 were cancelled. Of these 244 new licenses 206 were issued to supersede licenses previously held by inspectors in order to permit them to certificate other grains. Thirty licenses were suspended temporarily and 8 were reinstated, so that at the close of the fiscal year there were outstanding 443 active licenses and 28 held in suspension. Charges were preferred by the Secretary for misgrading of grain or other violations of the law against inspectors in three cases, following which formal hearings were held and the licensees placed on probation for a period of six months in each case. There were 121 inspection points at which inspectors have their licenses regularly posted and, in addition, 24 points which have been designated as inspection points.

APPEALS FROM GRADES ASSIGNED BY LICENSED INSPECTORS

During the fiscal year 1925 a total of 43,800 appeals were handled by offices of Federal Grain Supervision under the United States grain standards act, and Federal appeal grade cer-

tificates issued to cover. About three-fourths of the appeals were on wheat. The majority of these appeals were on carlots, but appeals were handled on cargoes to the amount of 24,295,000 bushels. Of the total number of appeals handled, 605 were referred to the Board of Review for final grade. Approximately \$45,000 was turned into the Treasury as appeal fees during the year.

DIVISION OF DAIRY AND POULTRY PRODUCTS

ROY C. POTTS, *in charge*

Dairy Products Investigations, ROY C. POTTS and D. L. JAMES; Poultry Products Investigations, ROB E. SLOCUM and J. M. BORDERS; Market News Service, L. M. DAVIS; and Dairy Inspection Service, ROY C. POTTS.

The work of the Division of Dairy and Poultry Products was continued along the following general lines: Research, investigation, and demonstration in the marketing of dairy and poultry products; market news service on dairy and poultry products; market news statistics on dairy and poultry products; and dairy and poultry products inspection service.

DAIRY MARKETING INVESTIGATIONS

The study of dairy marketing problems in New England and New York was continued and a preliminary report of the New England study was issued.

Surveys were made at Stillwater and Tulsa, Okla., of the local dairy marketing conditions, and at Stillwater assistance was given in the organization of a cooperative marketing association which will seek to improve the local marketing conditions and increase the price obtained by the milk producers for their products.

STUDIES OF EGG MARKETING MADE

A study of poultry and egg marketing in Europe which was begun during the previous year was completed and a bulletin prepared for publication. Surveys of poultry and egg marketing conditions were made in Georgia, North Carolina, and Illinois. The Georgia survey indicated that there were local and near-by markets in Florida for the present production of eggs and poultry and that the surplus production at present was not sufficient to warrant the producers undertaking to organize a cooperative

poultry and egg marketing organization.

The survey in North Carolina indicated need for better methods of marketing of poultry and eggs. It was, therefore, deemed advisable to cooperate with the North Carolina division of markets in employing a marketing specialist who would continue the investigation and cooperate with the extension service, county agents, and other agencies in demonstrating improved and better methods of marketing. The results already obtained clearly indicate great possibilities of improvement.

The survey in Illinois indicated that the methods of production and marketing of poultry and eggs in that State were in need of improvement. It was, therefore, proposed to form organizations of local groups of producers for the purpose of improving the quality of the poultry products marketed and of obtaining better prices by the use of bargaining methods.

COOPERATIVE MARKETING OF EGGS AND POULTRY

A preliminary report on the Cooperative Marketing of Eggs and Poultry was issued in June, 1925. This report covers statistical data on nearly 200 farmers' business organizations which market poultry products cooperatively. More than 2,000,000 cases of eggs were handled by 30 of the organizations and more than 15,000,000 pounds of poultry were marketed by 22 organizations in 1924. There has been a very large demand for this report, which contains a brief history of cooperative poultry and egg marketing in the United States.

STANDARDIZATION STUDIES CONTINUED

At a conference held in Chicago in January, 1925, under the auspices of the National Poultry, Butter, and Egg Associations the national standards of quality for eggs proposed by the bureau were adopted. A committee appointed at the conference to give consideration to the proposed national grades recommended by the bureau reported favorably on a number of the United States wholesale grades proposed which will be recommended for use as trading grades. United States retail grades were also proposed, and these are being given a thorough trial in connection with the egg-inspection service maintained by the bureau at New York and Philadelphia.

EGG CANDLING AND GRADING SCHOOLS HELD

A series of egg candling and grading schools was held in Minnesota, Arkansas, and Kansas in cooperation with various agencies, at which producers, local buyers, country packers, and shippers of eggs were instructed in the use of the United States standards of quality and in the candling, grading, and packing of eggs in accordance with the United States wholesale grades. Assistance was given the agricultural extension departments of the State college of agriculture in 22 States in conducting egg candling, grading, packing, and loading demonstrations. As a result of these demonstrations interest in national egg standardization was increased, and much work was actively undertaken by the State poultry extension specialists in egg standardization.

STUDIES OF BREAKAGE OF EGGS IN TRANSIT

A preliminary investigation was undertaken in cooperation with the Western Weighing and Inspection Bureau, Swift & Co., and other agencies to determine the efficiency of eight different methods of packing eggs in cases, and two methods of buffing or bracing the cases when loaded into cars to reduce breakage to a minimum. Twelve car lots of eggs were shipped from various points in the Middle West to various markets. A detailed report covering this investigation has been issued.

DETERIORATION OF EGGS IN TRANSIT

The receivers of eggs in the eastern markets have complained that eggs shipped from Duluth by boat via Great Lakes to New York arrive in very poor condition. Because of the fact that a saving of about \$100 per car lot in freight charges can be obtained by lake-route shipment, it is very advantageous to the shippers. At the request of the Minnesota State Department of Agriculture an investigation of the deterioration of eggs in transit by boat from Duluth to New York was undertaken.

MARKET NEWS SERVICE ON DAIRY AND POULTRY PRODUCTS

Letters of commendation and information received from many sources indicate that the statistics and market information contained in the market

news service reports are being more widely used and appreciated by the dairy and poultry industries. The statistics on production, storage movement, supply, and demand are becoming a fundamental and essential part of the basic economic information used in determining economic conditions and in making proper adjustment of prices to supply and demand conditions.

MONTHLY REPORT ON DAIRY SITUATION INAUGURATED

Monthly reports on the domestic and foreign dairy situations were developed during the year and are now issued monthly in mimeograph form. A great deal of interest has been manifested in these reports, and they are widely published by the daily press. A similar report on the domestic poultry and egg situation has been inaugurated.

MARKET NEWS REPORTS ON THE PACIFIC COAST EXTENDED

The market reports issued by the San Francisco office were extended to include additional information covering the carlot movement of eggs shipped from Oregon and Washington to points outside of these States. A daily report of receipts of dairy and poultry products at Los Angeles was undertaken in cooperation with the California State Department of Agriculture.

MARKET NEWS STATISTICS ON DAIRY AND POULTRY PRODUCTS

The market news statistical work consists of compiling reports on production of manufactured dairy products and certain statistical summaries which are of interest and value in obtaining a comprehensive view of the general economic trends and movements within the dairy and poultry industries.

The quarterly reports of production of manufactured dairy products are compiled from schedules received direct from over 9,000 dairy manufacturing firms in the United States and are the basis of statistical reports issued which show the monthly production of dairy products manufactured in the United States and of the annual production in each State. A cooperative arrangement was made with the New York State Department of Farms and Markets whereby the reports of factories in that State are received and edited by the New York State Department of Farms and Markets,

which forwards them to be tabulated and compiled in this bureau.

REPORT OF MILK CONSUMPTION IN CITIES COMPILED

A report of the annual consumption of milk in 354 cities in the United States for the year 1924 was compiled and issued. This report created a great deal of interest in the consumption of milk in different cities.

MONTHLY STATISTICS ON DAIRY AND POULTRY SITUATION

The monthly statistical summaries of the dairy and poultry industries which are included as a part of the monthly dairy and poultry situation show the monthly trade output of butter and eggs, and have proved to be extremely valuable as an index of consumption. It is planned to further extend this work to include other commodities and milk production as a whole.

INSPECTION SERVICE ON DAIRY AND POULTRY PRODUCTS

The inspection service on dairy and poultry products, which until the present year included only butter and cheese, was extended to include eggs on the New York, Chicago, and Philadelphia markets. The number of inspections has continually increased and negotiations have been made whereby all inspections of eggs for members of the Philadelphia Produce Exchange after June 30, 1925, will be made by an inspector representing this bureau on the Philadelphia market. In all the markets where the butter inspection service has been established, viz, Boston, New York, Philadelphia, Chicago, Washington, and San Francisco, the service has continued in favor and the total number of inspections increased. During the year Federal-State butter inspection service was established at St. Paul, Duluth, and Chicago in cooperation with the Minnesota State Department of Agriculture.

The inspection service on these markets was established primarily to provide an inspection service on butter for the Minnesota Cooperative Creameries Association (Inc.), a cooperative organization of more than 400 member creameries, which pools and markets more than 80,000,000 pounds of butter annually. In the inspection of butter for this association, every churning is inspected.

COLD-STORAGE REPORTS

WILLIAM BROXTON, *in charge*

The work of the cold-storage report section consists of compiling, editing, and preparing for publication the monthly cold-storage report, monthly fish cold-storage report, monthly report of livestock, slaughter, cost, and yields, and an annual survey of refrigerated storage space. The individual reports from which the complete figures are obtained are secured from public and private cold-storage warehouses, meat-packing establishments, public abattoirs, and fishery concerns.

DIVISION OF HAY, FEED, AND SEED

W. A. WHEELER, *in charge*

Hay Marketing Investigations and Market News Service on Grain and Hay, G. A. COLLIER; Feed Marketing Investigations and Market News Service, G. C. WHEELER; Seed Marketing Investigations and Market News Service, G. C. EDLER; Hay Standardization, E. C. PARKER; Hay Inspection Service, K. B. SEEDS; Broomcorn Marketing Investigations and News Service, G. B. ALGUIRE; Standardization of Beans and Peas, J. E. BARR.

STANDARDS FOR ALFALFA, PRAIRIE, AND JOHNSON HAY

United States standards for alfalfa and alfalfa mixed hay, prairie hay, Johnson and Johnson mixed hay have been formulated as a result of thorough and extensive investigations. The laboratory work was performed in the department's hay laboratories at Washington, D. C., and Kansas City, Mo., and in cooperative State laboratories at the University of Minnesota and the Alabama Agricultural College. Field and market studies were made under cooperative agreements with the State agricultural colleges of Kansas, Texas, Minnesota, Alabama, Arkansas, New York, Oklahoma, and Oregon, and much assistance was rendered by other State institutions and by various commercial agencies.

Twenty-three public hearings on the tentative standards were held in various States during the months of March and April, 1925. The proposed standards were very favorably received and only minor suggestions made as to their change.

United States hay standards now include timothy, clover, and grass hay, alfalfa hay, Johnson hay, prairie hay, and mixed hay. Numerical grades,

based on leafiness, color, and foreign material, are provided to cover the ordinary run of hay found in the markets, and supplementary grades to cover such special characteristics as "fine," "coarse," "soft," and "high green color." The Federal standards for hay have been adopted by the States of Alabama, Texas, Maine, New Jersey, North Carolina, Virginia, Maryland, Kansas, Oklahoma, Utah, Idaho, and Wisconsin, and adoption is now pending in 10 other States.

NEW METHODS OF MEASURING HAY COLOR

Green color in hay is an index to the feeding value and a very important price factor. During the past year the bureau has devoted much time and effort to the study of hay color and to the problem of measuring the amount of green color in hay, which varies according to the maturity of the hay plant, the extent of the weather damage, and the methods of curing. Through cooperative work with the Munsell Research Laboratories at Baltimore, the Munsell color indexes were adopted as the scientific standards for determining the amount of green color. A machine was devised by means of which it is possible to compare the amount of green color in a representative sample of hay extracted from a baled sample with the color of Munsell color index cards of known color value. The color measurements made by the Munsell system and the machine devised in this bureau make it possible to set up definite color standards and types for the purpose of training the eye of the hay inspector to recognize such types in car inspection.

GRAIN HAY STANDARDS BEING FORMULATED

The most important kind of hay not yet included in United States standards is grain hay, which is of particular importance to the Pacific Coast States. Work has started in the investigation of grades for grain hay under a cooperative agreement with the Oregon Agricultural College.

HAY INSPECTION EXTENDED

The extension of the hay-inspection service into new territory has been dependent largely upon the development of United States standards to cover the kinds of hay that were produced and marketed in regions where the inspection service is not now in

operation. There has been a steady growth in the number of inspections in the timothy and clover areas east of the Mississippi River. A total of 11,237 inspections was made in this territory during the first 10 months of this year.

Special attention has been given to the development of grades for alfalfa and prairie hay for the West, and alfalfa and Johnson hay for the South. Immediately following the preparation of tentative grades and prior to the publication of the official grades the States of Alabama and Texas entered into agreements with the department to adopt all Federal grades for hay and to put into effect an inspection service. Agreements are now pending in a number of the Western States where alfalfa and prairie hay are of importance and for which no United States standards have been available in the past.

In 1923 an arrangement was made with the United States Army under which the officers in attendance at the Army Veterinary School are given the training in hay inspection. An agreement has been completed between the War Department and this department by which all officers of the Veterinary Corps who have received the necessary training are licensed as Federal hay inspectors by this department, and 15 officers have been licensed under this agreement.

The hay inspection service has rendered assistance also to the Army and to other Government agencies purchasing hay. An inspector was loaned to the Army last winter to inspect 1,135 tons of hay offered for delivery at New York, which was to be shipped to Panama. The loss to the Government would have been \$5,845 if this hay had been accepted as of contract grade. Inspections made for other Government departments in Washington, Chicago, and Kansas City have resulted in an average saving on these purchases of \$1.59 per ton.

STANDARDS FOR BEANS

Studies of marketing practices and conditions, with special reference to the quality of beans entering commercial channels, have been made during the year for the purpose of working out standards for dry edible beans. As a result of these studies tentative standards were proposed and hearings were held in the six principal bean-producing areas during March and April, 1925. Opportunity was given to growers, shippers, dealers, and consumers to discuss the factors entering

into the construction of the standards and their application in the marketing of beans. These standards are permissive only, and may be used as a basis for grading beans by any State agency or trade organization, and the bureau has offered to help in every possible way to facilitate the interpretation and application of such standards. Several States have indicated their intention to make these standards their State standards.

TENTATIVE STANDARDS FOR SOY- BEANS

Tentative standards for soybeans were issued on October 10, 1924, for the use of State and commercial agencies in grading this product. Assistance was given to organizations, groups of producers, and shippers in the interpretation of the standards. The standards are being revised and will be published as recommended standards prior to the movement of the 1925 crop.

TENTATIVE STANDARDS FOR BROOM- CORN

Attention has been given during the past seven years to studying practices in marketing broomcorn and in publishing market news. A laboratory was equipped and is operated in conjunction with the hay standardization laboratory at Kansas City for a study in grading broomcorn. Although there are yet some rather intricate problems to solve, standards have been prepared and have been issued in tentative form for use by State and commercial agencies.

SEED REPORTS SET RECORD

The value of unbiased seed reports is evidenced by the increasing number who have asked to be placed on the mailing list to receive all information on seeds issued by this bureau. Approximately 100,000 mimeographed copies in the aggregate of the 110 reports issued were mailed to seed growers, dealers, consumers, and others.

The quality of the reports was improved largely because of more complete information from Europe and because more information was obtained from growers. The contacts made by a representative of the division in Europe a year ago have made it possible to obtain 150 special reports from correspondents regarding seed crop and trade conditions there.

The seed reports issued by this bureau keep seed growers, dealers, and consumers informed relative to the

supply of and demand for and prices and quality of all important kinds of field seeds. To be of greatest value this information must reach the grower before he sells his crop and must get to the consumer before he is ready to buy seed.

Three reports were issued for each of the important kinds of seeds—outlook, movement and price, and shipment reports. In addition weekly seed reviews from January 3 to May 27; a prospective seed demand report on February 27; monthly retail seed prices for March, April, and May; and a retail seed sales summary on July 9 were issued.

GRAIN MARKET NEWS SERVICE STRENGTHENED

The grain market news service was developed and additional market contacts made. The market for most grains is world-wide with domestic prices influenced by supplies and consumption in foreign countries. Heretofore only fragmentary reports of these conditions have been available to most farmers. This service, presenting a weekly review of the outstanding developments during the week, together with material changes in the underlying factors in the position of the market, gives information of value to farmers in planning their production and marketing activities. This information is disseminated widely.

Realizing that farm papers offer opportunities to bring economic information before large numbers of farmers, the special service provided for monthly and semimonthly papers has been extended to cover 10 farm and trade papers, with a circulation totaling 1,250,000, in which particular attention is given to the basic factors underlying the market situation, such as production, stocks, movement, and consumption in the United States and in foreign countries.

Reports upon the foreign barley situation were added to the service at the request of California barley growers who are especially affected by the export demand for brewing barley. Weekly London quotations are cabled through the bureau's foreign service, and growers are kept informed concerning crop conditions in competing countries and market developments at home and abroad. Grain marketing conditions in the Pacific Northwest were also studied with a view to making the grain market news service of greater value to the growers of that section.

HAY MARKET NEWS SERVICE EXTENDED

The market news service on hay was extended to cover important hay producing areas in the Southwest and in the Pacific Northwest, and the circulation of the weekly reviews was increased. This service presents each week a broad survey of the general hay market situation with a brief statement of local conditions at the more important markets.

In preparing the weekly reviews of the hay market the bureau's reports upon hay-crop conditions, production, and stocks are carefully studied together with regular market reports from picked correspondents at 20 important markets. To obtain prompt distribution the Saturday reviews are wired to Chicago, Minneapolis, and Kansas City and mailed out from these offices and Washington Saturday afternoon. These reviews are published in trade, daily, and weekly papers and are broadcast from many radio stations. A detailed report with prices of representative grades at important markets and receipts at leading markets is published in Crops and Markets, and a short account of the outstanding changes for the week is prepared for the daily marketgram.

Quarterly surveys are made of the movement of surplus hay to market and of the situation in consuming areas. This information, covering timothy, alfalfa, prairie, and clover hay, is embodied in the regular Saturday reviews, in the articles for Crops and Markets, and is given additional publicity through trade papers.

FEED MARKET REPORTS EXTENDED

The feed market news service was begun in 1917, and since that time it has been extended as funds would permit and as State agencies were in a position to cooperate with the bureau in the dissemination of the information supplied them. The information obtained for all of the reports issued and prices used are obtained from responsible dealers, brokers, and mills in all sections of the country.

Efforts are being made to get this information to farmers as soon as possible after the close of the market, and every effort is made to expedite the publication of these reports. The cooperation of State agencies has done much to develop and improve the service and to keep farmers well informed. All of the New England States, New

Jersey, New York, Pennsylvania, and several of the North Central States are now cooperating with the bureau in this work. Urgent demand has come from other important feed-consuming States for similar assistance, and as rapidly as facilities and funds become available the service will be extended to such States.

The feed market news service has been of great benefit to dairymen and others buying a large quantity of feed. The publication of wholesale prices has made it possible for purchasers of feeds to secure better retail prices from their dealers, thus eliminating the spread between wholesale and retail prices.

ADMINISTRATION OF THE UNITED STATES WAREHOUSE ACT

H. S. YOHE, *in charge*

Grain Warehousing, H. K. HOLMAN, Jr.; Wool Warehousing, C. NAGLE; Tobacco Warehousing, S. G. SWAIN, Jr.; Nut, Fruit, and Vegetable Warehousing, PAUL M. WILLIAMS; Cotton and Broomcorn Warehousing, under direct supervision of division leader; Tobacco Standardization, F. B. WILKINSON.

PURPOSE OF THE LAW

When Congress passed the United States warehouse act in 1916 the chief object in mind was the creation of a warehouse receipt covering agricultural products while in storage which would be generally accepted by bankers as security for loans. Through the accomplishment of this object Congress hoped to aid orderly marketing, both through growers' cooperative marketing organizations and through individual growers. Few farmers or farmers' organizations are in a position financially to hold their crops in storage while awaiting a favorable market. Moreover, a great many farmers were averse to storing their products in public warehouses, because of lack of proper supervision. The warehouse act encourages the storage of farm products by aiming to eliminate unsound and dishonest practices and by affording a real incentive to store agricultural products. The law permits the Secretary of Agriculture to license only such public warehousemen as are considered to be honest in their business relations, financially responsible, and thoroughly competent to care for the particular product offered for storage.

ADDITIONAL PRODUCTS STORABLE UNDER THE LAW

When the law was passed in 1916, it permitted the storage of four products only—cotton, grain, wool, and tobacco. In February, 1923, the law was amended so as to permit the Secretary to place such products on the eligible list for storage as might be considered properly storable under the law. Since then farmers' stock of peanuts, late crop of potatoes, broomcorn, dry beans, dried fruits, and sirups, both cane and maple, have been placed on the eligible list.

Before placing a commodity on the storable list extensive investigations are made to determine the best storage practices and methods of storage for the particular commodity in question. Particular attention is given to the type of storage house best adapted to the specific product under consideration. The care and thoroughness exercised in making these investigations

and in drafting regulations for the storage of new commodities is apparent from the following comment by one of the leading bankers of the country on a draft of proposed regulations for the storage of potatoes.

I have read the proposed regulation with a great deal of interest and have also requested some of my associates to go over it with a critical eye to detect, if possible, any defects that might tend to render its operation less than absolutely sound and thoroughly practicable. * * *

I am glad to be able to say that my associates concur with me in the view that the regulations seem to us to be not only practicable, but also designed with great skill to insure soundness and the security which should go with the proper warehouse receipt.

PROGRESS MADE IN LICENSING WARE- HOUSES

The number of licensed warehouses and the quantities of the different commodities that could be stored in them as of June 1, 1925, are shown in the following table:

Number	Commodity	Storage capacity	Number	Commodity	Storage capacity
340	Cotton.....bales..	2,677,712	2	Broomcorn.....bales..	2,000
270	Grain.....bushels..	27,713,410	2	Beans.....hundredweight..	40,000
12	Wool.....pounds..	21,984,000	1	Potatoes.....hundredweight..	16,000
84	Tobacco.....pounds..	634,212,000	3	Sirup.....gallons..	374,268
13	Peanuts.....tons..	14,637			

In addition to the warehouses for which licenses have been granted licenses have been issued to 1,431 persons to inspect, grade, and weigh products stored in licensed warehouses.

STANDARDIZATION WORK

Under the warehouse act authority is given to the Secretary to make investigations and to promulgate standards for agricultural products. For several years studies have been made with a view to developing standards for tobacco. During the past year a proposed system of classification by types of all the different tobaccos produced in the United States was developed. Grades for various types of tobacco developed by the bureau in tentative form have been in use for several years by various tobacco growers' cooperative associations. In April, 1925, hearings were held at three different points on proposed grades for what are known as the flue-cured types of tobacco. These grades will soon be completed and recommended tentatively by the department.

A NEW APPLICATION OF THE WARE- HOUSE ACT

A new development under the warehouse act was inaugurated in New England in the early fall of 1924. Connected with almost every large flour, cotton, or woolen mill is a first-class warehouse, usually owned by the mill itself, as it is usually necessary for a mill to carry stocks on hand. In many mill towns there are no storage facilities other than those connected with the mills, and since these mill warehouses are frequently first class and carry a low insurance rate it would be uneconomic to build others and to permit the mill facilities to stand idle.

Under the United States warehouse act a plan has been developed for leasing such warehouses to a person or corporation in no way connected with the mills. The lessee operates the warehouse, receives and delivers the product, and exercises complete control. The lessee of the warehouse, if he can meet the requirements of the warehouse act, can then be licensed and be in a position to issue licensed re-

ceipts as security to paper which becomes eligible for rediscount with the leading banks and the Federal reserve banks. This plan has been in operation and is meeting with success.

VIEWS OF BANKERS ON FEDERAL WAREHOUSE RECEIPT

Receipts issued under the provisions of the United States warehouse act are commanding more and more attention on the part of the leading bankers. Prominent financing institutions which lent practically nothing on agricultural products are now actually seeking loans supported by Federal warehouse receipts. The standing of this receipt is best shown by statements from various banking sources. In a public address to warehousemen, bankers, and cotton dealers the governor of the Federal Reserve Bank of Atlanta made this statement:

I know the value of securities from a banker's standpoint, and I know that the warehouse receipt issued by the warehouse licensed under the United States warehouse act is the best warehouse receipt that we have ever had in this country.

The Texas State Bankers Association at its annual meeting a year ago passed the following resolution:

Whereas the United States Government has provided the machinery through the enactment into law of the United States warehouse act whereby warehouses for the storage of certain agricultural products, including cotton, grains, and wool, may be licensed and bonded and operated under the supervision of the Federal Government, thereby creating a warehouse system issuing uniform warehouse receipts of superior value as collateral security and offering a means of improving present warehouse practice and receipts, such system being entirely permissive and optional with warehousemen whether they shall operate their warehouses under it;

Now, therefore, be it resolved that this association hereby approves the Federal warehouse system, urges warehousemen to apply for licenses under it, and member banks to encourage their local warehousemen to license and bond their warehouses in order to obtain for Texas bankers, merchants, and producers the benefits of the system.

Bankers in the Pacific Northwest who have handled grain and wool warehouse receipts issued under the United States warehouse act have a keen appreciation of the value of these receipts as contrasted with other receipts. The Washington State Bankers' Association and numerous others have heartily commended the administration of the Federal warehouse act.

BENEFITS TO PRODUCERS

The Federal warehouse act has repeatedly demonstrated its value to the producer, both as an individual and

as a member of a cooperative growers' marketing organization. The leading growers' cooperative associations have expressed appreciation of the services rendered through the United States warehouse act. Many of the cotton associations have stated that it was their intention to store cotton only in warehouses licensed under the United States warehouse act because receipts issued by warehouses under Federal inspection are more readily acceptable as collateral than those issued by non-members.

An instance of improper practices in warehouses not operating under the Federal law occurred a few months ago, when a farmer who had about \$30,000 worth of grain in storage sold the warehouse receipts to a dealer. When the warehouse receipts were surrendered for shipment there was no grain in the warehouse. The person responsible for the shortage was prosecuted, but the farmer lost his entire crop.

The fact that no farmer has suffered any loss in any warehouse operating under the Federal warehouse act would seem to indicate that his interests are protected by the enforcement of the act. Ordinarily warehousemen are willing to operate under the provisions of this law, but they expect the farmer and the banker to demand that they do so; and they expect that a distinction will be made between their receipts, if they operate under the law, and the receipts issued by warehousemen who do not operate under it.

Since receipts issued under this law are more generally acceptable to bankers and open up a wider field of credit at better interest rates, and since the farmers' products while in storage are protected and checked by Government examiners, the farmers should more generally insist upon warehousemen placing their warehouses under the provisions of the Federal warehouse act.

DIVISION OF AGRICULTURAL FINANCE

NILS A. OLSEN, *in charge*

Farm Credit, G. F. CADISCH; Farm Taxation, R. W. NEWTON, Farm Insurance

The work of the Division of Agricultural Finance centers around the problems of farm credit, farm insurance, and farm taxation. The problems in these fields have assumed added importance as a result of the depression. As the credit requirements

of farms have grown, it has become increasingly necessary that farmers be able to obtain credit in adequate amounts and on reasonable terms. The hazards in farming resulting from both crop damage and fluctuations in price are now receiving more adequate recognition. The development and use of insurance as protection against these hazards undoubtedly will help stabilize the farm industry. At a time when farm incomes were at low ebb, taxes mounted to their highest levels. This has brought a farm problem which calls for early solution.

CREDIT PROBLEMS OF THE FARMER

In the credit studies of the division an effort has been made to ascertain the changes in the financial condition of farmers. Surveys have been made of the amounts and kinds of credit needed by farmers, the sources through which the various kinds of credit may be obtained, as well as the terms and conditions under which the different agencies supply such credit.

During the last several years there has been a great deal of interest in the subject of farmer indebtedness. Farm debt increased to a marked degree between 1910 and 1920. A survey made in the summer of 1924 indicates that the indebtedness of owner-operator farmers has grown somewhat larger since 1920. This study shows that about 66 per cent of the total debt of owner-operators was in the form of farm-mortgage debt, 28 per cent in the form of short-term cash loan debt, 2 per cent in the form of merchant-credit debt, and about 4 per cent in all other forms of indebtedness. Farm-mortgage encumbrance appears to have increased while other forms of debt have decreased. Farmers evidently have been refunding their short-time debt into long-time mortgage loans that can be had for longer periods of time and at more reasonable cost.

Farmers obtain their mortgage credit from a number of important sources. According to the studies of the division, commercial banks have been and still are one of the most important sources of such credit. During the year 1923 the commercial banks of the country appear to have used about 41½ per cent of their total loans and discounts in making farm mortgage loans. During the last few years farm mortgage loans made by commercial banks have declined somewhat in volume. This tendency probably reflects in part the increasing competition of other farm

mortgage credit institutions. Life insurance companies have been for the last 50 years one of the most important sources of farm mortgage credit, and at the present time their loans are estimated to represent about one-fifth of the total mortgage debt. During the years of the depression the life insurance companies were especially responsive to the needs of agriculture. The farm mortgage companies have also been important agencies in mobilizing the capital of the country for the use of the farmer. The studies of the division also show that farmers obtain a great deal of their credit from other farmers and individuals. It is estimated, for example, that approximately 21 per cent of the total debt of owner-operator farmers in the summer of 1924 was held by other farmers and individuals. Perhaps, however, no credit agencies have served farmers in recent years more adequately than banks of the Federal land bank system. The extension of their activities has been especially marked since 1921.

The studies made during the past year have brought out the fact that significant changes have been taking place in the terms and conditions of farm mortgage loans made by various agencies. Since 1921 there has been a material decline in the interest rates of mortgage loans made by all credit agencies. The term of such loans also appears to have lengthened. The life insurance companies are making approximately 65 per cent of their farm mortgage loans for periods of 5 years and 14 per cent of them for 10 years. Farm mortgage companies also are making many loans for periods of reasonable length. On the other hand, only 26 per cent of the loans of State and National banks are made for a period of five years. Over 70 per cent of the farm mortgage loans of commercial banks in 1923 were made for five years or less. Since the loans of the Federal and joint-stock land banks are most commonly made for periods varying between 30 and 35 years, it is probable that their policy has influenced the term of loans made by other agencies.

A special study has been made during the past year of short-term bank credit for farmers. A large percentage of the short-time loans of farmers is obtained from commercial banks. The survey shows that the short-time loans of banks to farmers in 1923 amounted to about 9.5 per cent of the total loans and discounts of all banks. Commercial banks as a rule make per-

sonal and collateral loans to farmers for relatively short terms. Almost 75 per cent of such loans in 1923 were for periods of six months or less. Most of the loans for periods longer than six months were made in the West and South. A number of significant regional differences appear in the matter of security for such loans. Advances on notes without indorsement are most prevalent in the Middle West, on indorsed note and on stocks and bonds in New England, on livestock in the range country, and on crop liens in the South and in the Northwest.

Interest in the credit problems of agriculture is widespread. Many requests have been made for information in regard to both Federal and joint-stock land bank loans. Many inquiries also have been received in regard to the intermediate credit system established in the spring of 1923. The division has given farmers advice and assistance in utilizing the credit systems provided by the Federal Government.

A study made of the assets of farmers in 1924 shows that for the country as a whole about 79 per cent of the capital of owner-operators covered in the survey was invested in farm land, buildings, livestock, and machinery; about 21 per cent in stocks, bonds, cash, and other assets. The farm business requires a large fixed capital investment, but the difficulties experienced by many farmers during the depression point to the need of investing more of their funds in liquid reserves upon which they can readily draw.

FARM INSURANCE PROBLEMS

The hazards in farming are many and great. These hazards may be materially reduced through the use of insurance. Insurance does not eliminate hazards, but it distributes them from the individual to the group.

According to the best estimates the value of farm property insurable against fire in 1920 amounted to about \$26,000,000,000. A great deal of farm property in 1920 was not covered by insurance, especially in the South. Farmers obtain insurance against fire through joint-stock fire insurance companies and through farmers' mutual fire insurance companies. The studies of this division show that the farmers' mutual fire insurance companies in general have been very successful. At

the present time there are approximately 2,000 companies, carrying risks amounting to over \$8,000,000,000. Most of these companies are located in the East and Middle West. The extension of mutual companies to the South has been retarded partly because of tenure and race conditions and partly because of inadequate laws. The cost of insurance in farmers' mutuals has averaged around 26 cents per \$100 annually. The cost of fire insurance in old-line companies has ranged from \$0.35 per \$100 in some of the Northern States to \$1.50 per \$100 in some of the Southern States. The studies of the division point to the conclusion that more farmers' mutual fire insurance companies could be organized to advantage, especially in the South.

The farmer should also carry insurance against severe and unpreventable loss to his crops. This loss may result not only from hazards such as plant diseases and insect pests that reduce crop yields but also from fluctuations in price. In some measure the farmer may guard against unnecessary losses by properly diversifying his crops, testing and treating his seed, building up reserves for protection in bad years, and the like. But there are crop losses against which he can not protect himself, and such hazards should be covered by insurance. Most progress has been made to date in the insurance of specific hazards, especially hail and frost. This type of insurance, however, does not adequately meet the crop-insurance needs of the farmer. What is needed, therefore, is a form of general crop insurance that will afford the farmer protection against all hazards over which he has no control. There are many difficult problems in this field and the division has devoted some time to their solution.

FARM TAXATION PROBLEMS

The complaint has been general that farm taxes are relatively too high. Between 1914 and 1923 taxes on farm property of the United States are estimated to have increased about 140 per cent. During the same period the value of farm products increased but 58 per cent. While taxes thus mounted, the funds from which they were paid were not correspondingly increased. This added tax burden came at a time when the purchasing power of the farmer was at low ebb and when he was least able to bear it. The studies

of the division during the past year have shown that the tax burden on the farm industry is relatively greater than that on most other industries.

Most of the taxes paid by farmers are for State and local purposes, and these revenues are obtained largely through the general property tax. As at present administered the general property tax does not distribute the tax burden equally between farmers and other classes. Most of the property possessed by the farmer can be readily placed upon the assessment rolls, whereas a large part of urban property is in intangible form and not easily found by the assessor. Furthermore, sale value of farm land is now used as a measure of tax liability. Since, however, the turnover in lands is relatively low, farm assessments are based largely on the personal opinions of the assessors. The values placed upon farm lands for assessment purposes are therefore frequently larger than the earnings of such land warrant. Inequalities in taxation, both as between farmers and between farmers and urban people, have multiplied and need correction. It is believed that a step would be taken toward a better equalization of the tax burden if land earnings were taken more into account in the fixing of taxable values.

The bulk of the farmers' taxes are levied purely as local taxes. In 1923, for example, over 76 cents out of every dollar paid by Indiana farmers was levied for the support of schools and roads. The maintenance of schools and roads, however, should not be regarded as simply a local function. The State as a whole is vitally interested in the education of the farm boy and girl, and in a system of good roads, but at the present time many States carry a relatively small part of the burden of providing adequate rural school facilities and good roads.

Because of difficulties in interpreting State and Federal reports dealing with farm-tax problems, the division has sought to obtain greater uniformity in such reports. An effort has been made to obtain statistical reports from which may be shown the comparative school cost for urban and rural communities. It is also believed that the income records of the Internal Revenue Bureau can be made much more useful in studies of the tax problem.

DIVISION OF STATISTICAL AND HISTORICAL RESEARCH

O. C. STINE, *in charge*

Foreign Competition and Demand, G. B. L. ARNER, E. C. SHOUR, and L. V. STERE; Statistical Analysis, B. B. SMITH; Market Statistics, LOUIS H. BEAN and LEWIS B. FLOHR; Production Statistics, E. M. DAGGITT; Transportation, J. G. CROSS; Graphics, T. D. JOHNSON.

Prices and probable future prices for farm products are questions of paramount importance. One of the objects of the work of the Division of Statistical and Historical Research is, therefore, to provide a basis for forecasting prices through the collection of data and the keeping of records of production, prices, and of all the factors that influence the demand for farm products, both in the United States and in foreign countries.

Studies are made of general economic problems that especially refer to the relation of agriculture to other industries in an effort to contribute to the development of a national agricultural policy. No intelligent study of economic problems can be made unless all the facts are available and comprehensive data have been compiled. This division acts as a clearing house, therefore, for statistical data relating to all phases of agricultural economics. These data are prepared for current publications, are compiled for publication in the Yearbook of the department, and are used as the basis for economic studies both in this and other divisions.

FOREIGN COMPETITION AND DEMAND

With a large share of our agricultural production finding a market abroad, the farming interests of the country are vitally interested in everything influencing foreign demand for their products. The current production, market, and international trend information is designed to assist farmers and their organizations, dealers in agricultural products, and the large body of men in positions where they influence the agricultural policies of the country in deciding when and how our products should be marketed, what prices may be expected, and in otherwise developing sound production and marketing policies. Information as to methods of production, costs, potentialities, and trends of production in competing countries, together

with tendencies in market demand, furnish the basis for adjusting production to the demand for products or determining what and how much to produce.

The chief sources of foreign information are the following:

Agricultural commissioners at London, Berlin, Vienna, and Mexico City.

Special representatives of this bureau studying the production and marketing of specific commodities in the foreign field.

The International Institute of Agriculture at Rome, which secures and transmits reports from 70 countries.

The 400 consular officers of the Department of State.

The attachés and commissioners of the Department of Commerce.

Foreign agricultural and statistical departments through direct cable communication.

Foreign correspondents who report directly to this bureau.

Through the International Institute of Agriculture at Rome information is collected by wire and mail from all the leading countries of the world. Nearly one-third of the information received by this bureau comes through the institute of agriculture.

Cooperation with agencies in foreign fields is maintained and stimulated by the work of the foreign representatives of this bureau. Six members of the staff of this bureau are stationed in Europe at the present time who make arrangements for the exchange of information with foreign agencies and keep the bureau informed with regard to agricultural developments in foreign countries.

Through cooperation with the Department of State the services of 400 consuls, scattered all over the world, have been utilized in collecting information not covered by the International Institute of Agriculture. The agricultural commissioner at Berlin spent one month interviewing consuls through Italy, France, and Spain relative to reports on agricultural subjects. The effort which our foreign service has put forth in the direction of closer cooperation has had concrete results during the past year in better and more frequent reports.

Closer relations have been established with the Bureau of Foreign and Domestic Commerce with regard to the exchange of agricultural information. Copies of cabled messages received from the agencies of the Department of Agriculture and from the International Institute of Agriculture are sent to the Department of Com-

merce. In return the files of material submitted by field agents of the Department of Commerce are open to this bureau.

Direct cable exchange is maintained with the Governments of India, Norway, and Canada. Cabled information from Argentina is received through the Argentine Embassy.

In order to keep the American producer constantly informed of the latest developments in world agricultural conditions, probable production, and probable demand, world tables of production of all major crops and classes of livestock are kept up to date.

Reports received by cable or telegram are promptly prepared for release to the press and are also telegraphed to agencies and persons known to be interested. An interpretative statement for publication is prepared on the basis of the comparison of the current report with previous reports in order to indicate the significance of the information to American agriculture.

In addition to being distributed to persons interested by telegraph and mail, and given immediate publicity through the press, the data collected are published in *Foreign Crops and Markets*, *Crops and Markets*, bulletins, and the *Yearbook*.

SURVEY OF WORLD AGRICULTURE

Agricultural surveys of Italy, Germany, and Switzerland have been practically completed. Field work in Poland is in progress at the present time. These surveys provide in concise form the data which, together with current reports, serve as the basis for estimating changes in area and production of crops and numbers of livestock. It is planned to add constantly to the completeness of this world survey.

FOREIGN MARKET REPORTING

* Special attention is being given to reporting foreign markets and market conditions and trends of prices with a view to keeping our agricultural producers informed where and how their products can be most advantageously disposed of. Cable service has been greatly expanded and methods of preparing, handling, and disseminating special cable reports have been developed.

Regular weekly and monthly cables on the foreign pork market have been received since early last August and have been given distribution through regular channels of publication and

the leased wire. Close touch is kept with the trend of the butter market in England and Denmark by cables received each Friday from the American agricultural commissioner in London. A review of the foreign situation as affecting the market for dairy products is published each month. Additional regular cable reports on imports of fruit into certain foreign markets have been inaugurated during the present year. Cables on wool prices for various grades, sales, clip, stocks, etc., are received from consuls at Melbourne, Australia, and Wellington, New Zealand. Reports have also been received from the colonial wool sales held at regular intervals in London. The consul stationed at Progreso, Yucatan, cables on the hemp situation near the first of each month. Consuls in China and Japan send reports on peanuts in January and November of each year. New codes have been prepared for reporting on both apples and citrus fruits during the coming season which will enable the transmission of very detailed reports at no increase in cost over the present method. A series of foreign prices at various markets is being built up and wage and employment data bearing on foreign agricultural conditions are also being collected.

Studies in international trade problems and a series of records of exports and imports with source and destination provide a gauge of the ability of foreign countries to buy from us and their ability to buy from our competitors. An index of agricultural exports has been completed which gives for the first time a measure of the relative volume of the gross exports of farm products. An annual index of the surplus of foodstuffs covering the period from 1880 to 1924 has been prepared. This index number takes into account both exports and imports of foodstuffs and is a measure of the effective surplus of food products from year to year. The relation of international trade practices, tariffs, and ocean rates to international trade has also been given consideration. A study has been made of the tariff and its effects upon the production and price of a number of the most important farm products. Information regarding the foreign and domestic tariff rates on specific agricultural commodities and on commodities which the farmer buys has been compiled. The tabulation of import and export statistics for all the principal agricultural prod-

ucts of the United States and foreign countries has been continued. A very comprehensive file of statistical information embracing more than 350 tables is constantly kept up to date.

PRICE FORECASTING AND STATISTICAL ANALYSES

The development of bases for forecasting prices through statistical analyses is of particular significance. These analyses include the effect of both supply and demand upon price. They involve a study of the factors affecting demand and the measuring of the effect of the several factors upon price. Both general demand conditions, such as movements of the business cycle and changes in price level, which affect the price for all agricultural products, and demand factors which affect the prices of specific products, such as prices of competing products and employment and wages of consumers of the products, are being measured.

For measuring domestic demand, statistics of business activity, employment, wages, and prices of commodities other than agricultural products are being collected from the various sources from which they are available. For measuring foreign demand, figures representing exports of agricultural products and the prices at which they were taken, also employment, wages, and business conditions in foreign countries, are being compiled.

The studies begun last year on the price of oats and forecasting the price of hogs have been continued. Definite progress has been made on wheat-price studies, and a preliminary paper entitled "A Method of Estimating the May Price of Spring Wheat" has been published, which attracted wide attention.

A bulletin on agricultural prices is now in preparation which will contain a discussion of agricultural price fluctuations, methods of finding and measuring the effect of price factors, description of the new index of farm prices, and their significance in terms of agricultural purchasing power. In addition the bulletin will contain a number of historical price series which should form the basis for studies in price forecasting.

In cooperation with the Cotton Division studies are being made on forecasting cotton prices and relation of prices to subsequent acreage, consumption, movement, and exports.

INCOME FROM AGRICULTURAL PRODUCTION

A statement on income from agricultural production, 1919 to 1924, a preliminary estimate on income for the year 1924-25, and an analysis of the study and a description of the method used have been prepared.

PRODUCTION AND MARKETING STATISTICS

A very comprehensive file of statistics is compiled and kept up to date relating to the area, production, yield, value, market prices, prices to producers, and movement of the principal farm products, and tabulations are prepared for publication in Crops and Markets, in statistical bulletins, in the department Yearbook, and for use in preparing special reports. These tabulations serve also as the basis for much of the research work of the bureau, and improvements are constantly being made in the completeness and accuracy of the statistics obtained and made public. Special study is being given to the preparation of a price series which will be useful to the industry and to the trade.

DIVISION OF AGRICULTURAL CO-OPERATION

CHRIS L. CHRISTENSEN, *in charge*

Economics of Cooperation, A. W. McKAY;
Accounts and Business Practices, A. V. SWARTHOUT; Statistics of Cooperation, R. H. ELSWORTH; Legal Phases of Cooperation, L. S. HULBERT.

The value of farm products sold through cooperative associations during 1924 was practically four times as great as in 1915. New problems in cooperation are arising, and questions of rural finance, insurance, production programs, transportation, and distribution are influenced by the activities of the farmers' marketing and purchasing associations. The future of the movement depends on the successful solution of economic problems rather than on the advocacy or adoption of special forms of organization, and on the education of the members in the principles and aims of cooperation.

There has been a heavy demand on the bureau for information regarding the experiences of successful organizations, for instruction in the tested principles of cooperation, and for guidance in meeting membership, business, and legal problems. The Division of Agricultural Cooperation

has the responsibility of collecting and disseminating reliable information regarding cooperation, of studying and analyzing its possibilities and limitations, and of rendering such service to associations and groups of producers as will enable them to set up and maintain sound and efficient organizations.

The research and service activities have the following objectives: (1) The development of cooperative associations based on the needs of the community or industry; (2) the adoption of more efficient operating and merchandising methods; (3) simplification of such special problems as pooling, financing, membership information, and marketing contracts; (4) to contribute to a clearer understanding by the farmers and the general public of the aims and functions of cooperation.

HISTORY AND STATISTICS OF CO-OPERATION

Reports have been received from more than 10,500 active associations in this country. For the majority, very full information is given covering the membership, volume of business, financial condition and management, and merchandising methods over a period of years. The files of the bureau thus form a source library regarding agricultural cooperation, which is already of great value, and the value of which is enhanced each year.

A statistical bulletin of 76 pages, entitled "Development and Present Status of Farmers' Cooperative Business Organizations," was issued during the year. The bulletin contains in tabulated form the essential information collected in nation-wide surveys of cooperation made during the years 1913, 1915, 1919, 1921, and 1923. The 10,160 associations considered in compiling the bulletin are classified according to commodities handled and the States in which they are located. Six preliminary reports dealing with the statistics of cooperation were prepared and issued in mimeographed form.

STUDIES OF COOPERATIVE MARKETING

A study of the organization of cooperative elevators in North Dakota and Minnesota was begun for the purpose of developing the factors that affect the efficient management of farmers' elevators in the spring-wheat region. The study aims to develop the factors which enable a farmers' ele-

vator to operate as a successful business institution.

A study of the management and costs of operating cooperative cotton gins was also begun. Interest has been aroused recently in the possibilities of the cotton gin as the basis of a cooperative unit whose members may affiliate with the State-wide cotton marketing associations. Very little is known of the cost of operating cotton gins, the best methods of operation and management, or the volume of business necessary. The bureau has undertaken to collect this information in Texas, and in North Carolina in cooperation with the agricultural college of that State.

A general study of cooperative marketing of cotton was made, the results of which will be presented in a bulletin. A study of the marketing of fruits and vegetables through cooperative associations was also concluded and is now in manuscript form. A bulletin treating of the operating methods and expense of local citrus associations in California appeared at the beginning of this fiscal year. A mimeographed report on the cooperative marketing of poultry and eggs has been prepared in cooperation with the Division of Dairy and Poultry Products.

COOPERATION WITH STATE AGENCIES

A general survey of the organization and operation of farmers' elevators in North Dakota was conducted in cooperation with the North Dakota Agricultural College. A survey of the marketing of North Carolina strawberries, with special reference to the possibilities of cooperative marketing in this region, was made in May, 1924, and a report prepared for publication.

A survey of cooperative organizations in California was carried on during the year in cooperation with the University of California. Studies of the operation and management of farmers' elevators in Minnesota and of the volume of business in relation to marketing costs of cooperative cheese factories in Wisconsin have been carried on in cooperation with the State universities.

ACCOUNTS AND BUSINESS PRACTICES

The development of cooperative marketing has brought forward new business problems and has also placed groups of producers in positions of business responsibility. In order to study the problems of operation, man-

agement, and merchandising and assist cooperative associations in introducing into their operations the most modern and efficient business practices, a section of accounts and business practices has been organized. The bureau furnishes the services of trained investigators who are able to analyze the methods of individual cooperative associations and to determine and isolate the management factors which need correction. The cooperative associations have been quick to appreciate the value of this service, and the demand for it now is greater than can be met in the immediate future.

A study of the Western New York Fruit Growers Packing Association, Rochester, N. Y., was completed during the latter part of the year and a comprehensive report made to the board of directors and a summary was made available to each member in the association. The board of directors of the association adopted resolutions which put into effect all the major suggestions made by the bureau. At the request of the board of directors of the Staple Cotton Cooperative Association, Greenwood, Miss., the bureau is now engaged in making a similar study of that association.

SERVICE ACTIVITIES

The service work includes the dissemination of general information regarding cooperation to the public, and special information to groups interested in forming cooperative associations. It includes also surveys of the production and marketing conditions under which an association must operate, and assistance in the solution of membership, legal, and business problems of existing organizations. A brief survey of the possibility of marketing Mississippi truck crops through a centralized association was made during the year and a report rendered to a committee of growers and merchants interested in forming such an organization.

Attention has been given to membership or field service problems of cooperative associations, particularly in the large cotton and tobacco associations. Representatives of the bureau have met with various groups and committees interested in developing plans for maintaining adequate and suitable contacts between the management and the members for carrying on educational work and for disseminating information. Two mo-

tion pictures have been made and released, Cooperative Marketing—Cotton and Cooperative Marketing—Tobacco.

Members of the staff have been in frequent attendance during the year at meetings of farmers and extension agents, particularly at meetings of members of cooperative associations. At such gatherings the principles and problems of cooperative marketing have been discussed and the limitations, as well as the possibilities of cooperation, have been brought out, and the responsibility of the individual grower toward his organization has been emphasized.

An important feature of the service work of the division is to bring to the attention of associations the information and services available in other divisions of the bureau. Crop and market reports, outlook reports, storage holdings, and similar information are especially valuable to associations; and it is important also that they should understand the warehousing, standardization, and inspection services offered by the bureau and the results of special studies in finance, insurance, cost of marketing, and similar fields.

Legal questions have been presented during the year, and cases and decisions bearing on such questions have been cited. A second mimeographed circular containing reports of court decisions affecting cooperative associations was issued during the year.

Agricultural Cooperation, a mimeographed publication of 20 pages, now goes to a mailing list in excess of 3,000 persons, many of whom are officials of cooperative associations. The publication contains current legal and statistical information regarding cooperation in the United States and foreign countries.

DIVISION OF FARM POPULATION AND RURAL LIFE

C. J. GALPIN, in charge

Rural Population Statistics, VEDA B. L. TURNER; Population Aspects of Rural Community Buildings, W. C. NASON; Farmers' Standard of Living, E. L. KIRKPATRICK.

In order to understand the researches of this division it must be borne in mind that in the national problems of agriculture farm population is as truly a major economic factor as land or capital. This fact furnishes a guiding principle in de-

ciding the type of research to be carried on.

STATISTICS OF FARM POPULATION ON SCIENTIFIC BASIS

Definite information, including correct statistics of the number of persons of all ages on farms, the movement from farm to city, the reasons for such movement, the cost of living on farms, the facilities for education, recreation, and health, and the relation of the burden of taxation upon farmers to their ability to pay taxes, all have a very important bearing upon the problem of securing a stable agriculture with its accompanying influence on the national welfare.

In order to get statistics which are of the most practical value farm population should be shown by county and State. Demonstration tabulations of the farm population of several counties have been prepared and submitted to university laboratories for study and use. It is hoped that in the not distant future State and county farm population statistics will be as available for use in shaping agricultural policies as are now the facts relating to farm crops.

THE MOVEMENT OF POPULATION FROM FARMS

An extensive inquiry has been made over the Nation, county by county, as to the movement of population to and from farms during the calendar year 1924. An analysis of this survey shows that the net loss to the farm population for this year was 182,000, as compared with a net loss of 460,000 in 1922. The gross movement from farms to cities in 1922 was 2,000,000, compared to 2,075,000 in 1924. The gross movement back to the farms, however, in 1922 was 880,000, compared to 1,396,000 in 1924, or a very decided increase in 1924. These figures are shown by geographical divisions and serve to some extent as an index of prosperity.

THE FARMER'S STANDARD OF LIVING

The educational work of the bureau has pointed to the fact that if the farm community is to retain permanent prosperity it must come through the establishment of standards of living comparable to the standards of those engaged in city industries. Consequently, this division is devoting itself to the ways and means of maintaining satisfactory standards of living for farmers.

The standard of living studies have engaged about half the energies and resources of the division during the current year in an effort to complete the first stage of a national study of this subject. The results, State by State, have been put out in mimeograph preliminary reports: one bulletin manuscript, collecting the results of the first stage in all States, is in process. A second stage of study is being projected for the coming year's work, which will attempt to relate the standard of living on farms in each State with the income of the farm families in that State for the purpose of reaching national indices of both living and income.

ECONOMIC LIBRARY

MARY G. LACY, *Librarian*

The Economic Library consists of the statistical collections of the department relating to acreage, production, prices, etc., of agricultural crops as well as the collections on economics, cooperation, marketing, rural economics, land and rent, labor and wages, finance, and commerce.

During the year the library has compiled 44 bibliographies and selected lists. The appreciation of these, as shown by the requests that have come for them and the commendatory letters received, has been very gratifying. This library is believed to comprise the strongest collection of agricultural statistics in this country and probably in the world, and for that reason work has been started on the compilation of a series of source books showing the official sources of various types of agricultural statistics, both domestic and foreign, and official publication of these books will be of great benefit.

DIVISION OF LAND ECONOMICS

L. C. GRAY, *in charge*

Land Resources and Utilization, O. E. BAKER; Land Reclamation, R. P. TEELE; Land Settlement, B. HENDERSON; Land Tenure, O. M. JOHNSON; Land Values, E. H. WIECKING; Farm Labor, J. C. FOLSOM.

The work assigned to this division consists of research in land economics and farm-labor problems. In addition, the division is called upon for work in connection with the general activities of the department. During the past year the economist in charge served as chairman of the departmental committee appointed to cooper-

ate with the Bureau of the Census in planning and taking the agricultural census of 1925, and another member of the staff served on this committee.

LAND UTILIZATION

Work has been continued along the lines of estimating probable future needs for land for agricultural purposes. Effort has been made also to encourage the classification of the lands now unused or little used, in order that their potentialities for meeting future needs may be determined, and policies may be formulated which will bring such lands into the uses for which they are best adapted as they are needed. Attention has been given to showing the need for this classification of our land resources and to a study of methods used in the few places where classification is being undertaken by public or private agencies.

Studies in the Great Plains area, for the purpose of developing the best system of utilizing the land of that region, have been continued. Preliminary reports of surveys made in previous years in the central Great Plains were issued during the year, and additional studies were made in the southern Great Plains, in Texas, and New Mexico.

Preliminary work has been done on a similar study to be made in the "piney woods" section of the South Atlantic and Gulf States, in cooperation with other bureaus of the department.

A study of the trend of food consumption in the United States since 1839 in relation to the utilization of land resources has been completed. Parallel with this, special studies have been made to determine the trend in yields per acre of important crops and the factors which appear to be responsible for these trends.

LAND RECLAMATION

Land-reclamation policies of the United States and of the several States have been reviewed and a bulletin published. This bulletin gives a résumé of the experience of this country to the present time, and makes recommendations as to future policies. This has been followed by extensive field studies to determine the economic limits of the cost of water for irrigation. This work has been carried on in cooperation with the Bureau of Public Roads. Field surveys were made in the Southwest in the spring

of 1924, and much more extensive studies were undertaken in the winter of 1924-25 in connection with the taking of the agricultural census. Reports were obtained from several thousand farmers operating irrigated farms, and these are being tabulated.

LAND SETTLEMENT

An important phase of this work deals with methods used by States and private individuals and agencies in inducing settlement on lands that have not been used for agriculture. During the past year a bulletin entitled "Land Settlement and Colonization in the Great Lakes States" was issued. A field study of the policies of the several States with regard to aiding, supervising, or controlling land sales and settlement was made and a report prepared and submitted for publication. A study of the methods used by private land settlement agencies in classifying the land offered for sale is being made.

LAND TENURE

The results of several studies of land tenure, covering the relations between landlords and tenants, etc., were published during the year. A survey of the landlords reported in the census of 1920 has been made to determine whether there is a dangerous accumulation of farms in the hands of a landlord class. This study indicates that no such tendency has developed in our country as a whole. Two bulletin manuscripts on this subject have been completed during the year.

A questionnaire calling for information as to changes in land tenure has been sent out to a large number of correspondents, and the replies are being tabulated.

Two local surveys were made for the purpose of providing more detailed pictures of tenure conditions in particular regions than can be obtained from other sources of information. One of these, located in central Kentucky, will supplement other information obtained in past years and make possible the completion of a general bulletin on land tenure in that region. The other survey is located in northern Georgia, a region of extensive white tenancy.

LAND APPRAISAL AND LAND VALUES

Studies of the effect of various factors influencing land values have been made during the year in cooperation with the Bureau of Public Roads. The objects of these studies are to de-

velop methods of appraising land values as a guide to purchase and sale, assessment for taxation, and credit policies, and to serve as a guide in planning expenditures for improvements and the development of a sound farming policy.

Long-time records of land prices are being compiled from county records of sales and other sources, and an attempt is being made to measure the influence of various factors on sale prices and on the trend of such prices. During the year such records were obtained in Indiana, Illinois, Wisconsin, Iowa, Nebraska, Missouri, Texas, Tennessee, Kentucky, North Carolina, South Carolina, Georgia, and Alabama.

FARM LABOR

During the year a bulletin, "Truck Farm Labor in New Jersey, 1922," was completed and published. A reconnaissance survey was made in Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, and the New England States covering the agencies placing farm labor, farmers' practices in handling labor, farm labor supply and demand, and general farm labor conditions. Studies have been made of the monthly variations in amounts of family labor and hired labor on farms and the demands for harvest labor and methods of meeting this demand. A further study of farm labor conditions is being made for the purpose of showing the expenditures for farm labor and the part of the production that goes to meet labor expense. It is proposed to show also the proportion of the farm population engaged as hired labor, and the relationship of the agriculturally employed population to the area of land and the value of farm property in the various local communities of the United States.

DIVISION OF INFORMATION

J. CLYDE MARQUIS, *in charge*

Editorial Economist-Statistician, S. W. MENDUM; Editorial, Miss C. B. SHERRMAN; Mrs. A. R. DISNEY; Consumer Demand, L. A. ADAMS; Periodicals, A. B. GENUNG, C. E. TROUT; Miss C. M. VEHMANN; Press Service, F. GEORGE, Jr.; Radio, J. C. GILBERT; Exhibits, B. L. PERKINS; Handbook, M. A. CROSBY; Photographic Laboratory, H. C. WILCOX.

The distribution of economic information involves two general groups of material: (1) Current market news or matter that must be given immediate distribution through the press, by

radio, and by wire; and (2) general economic information of less timely importance but of value to farmers and others in making plans for future operations, which is distributed in various periodicals, bulletins, reports, and special articles.

The great effort in news service work is to gather and distribute the reports promptly and to make them available for producers, traders, and others as soon as possible. The wider use of radio as a distributing agency has made it possible to speed up market news for farmers so that they are now almost as promptly served as the trade, which formerly had an outstanding advantage because of its location close to marketing centers.

The splendid cooperation of all news-distributing agencies must be acknowledged. A decided increase in the distribution of information has occurred in the form of materials prepared for extension workers. During the year a number of State extension directors have cooperated with the division in organizing almost complete programs of market-news information for their States, utilizing all the distributing agencies, the press, farmers' organizations, and radio as extensively as possible.

One of the chief objectives of the division has been to facilitate distribution by the use of mimeographed preliminary reports and through the mimeographed periodicals. The bureau is now preparing and editing five mimeographed publications, which are sent to leaders doing educational and extension work. These periodicals serve to give the workers immediate access to useful material.

An index of economic charts available in the bureau was prepared and distributed to extension workers, together with a price list at which prints and enlargements would be provided by the bureau. By this means a greatly increased use is being made of charts, many of which heretofore were not distributed in any way.

PRESS SERVICE

More effective distribution of the results of the bureau's work has resulted through the development of closer contacts with the newspapers, farm journals, and magazines, with an effort to adapt our material more closely to the needs of each publication, and to give articles a local and regional appeal whenever possible.

Conforming to the general department policy to reduce the number and

size of press releases and to improve their form, about 300 releases, ranging from short items to articles of 1,000 to 2,000 words, have been distributed. A large volume of material has been distributed through close contacts with the Washington correspondents of various trade journals and newspapers particularly interested in cotton, wool, and general business conditions. Close contact has been maintained with the news agencies, such as the Associated Press, with the result that their representatives have given wide distribution to numerous special articles which otherwise would not have been handled. Special effort has been made to assist feature writers for newspapers and magazines to obtain material for their articles, and press clippings indicate that material from this bureau is now receiving wide distribution. Branch-office workers have been urged to assist local correspondents in the preparation of articles with local emphasis based upon various reports issued by the bureau until we now have in our branch offices a means of contact with the press that is of great importance.

The weekly review of the grain market has continued to expand in circulation until it is now distributed throughout the country from a number of our branch offices. Late in the year a special barley review was begun for California barley producers, including attention to foreign market conditions.

The daily Marketgram has been continued during the year and is now distributed from six offices on the leased wire. This goes to about 2,000 weekly newspapers and to a number of plate-service agencies which distribute it in connection with their service. It is difficult to estimate the total circulation of this report, but it provides the only national market review that appears in many weekly newspapers.

RADIO NEWS SERVICE

The use of radio for farmers has increased steadily during the year. The number of radio sets owned by farmers has been estimated by various agencies. In some States from 15 to 20 per cent of all farms own sets. The bureau contacts with radio stations which are maintained primarily from branch offices have been strengthened during the year by providing more complete reports. The number of stations has not increased greatly but the scope of the programs has been steadily expanded.

An outstanding development has been the opening of broadcasting stations devoted primarily to agriculture. The station WLS of the Sears-Roe-buck Agricultural Foundation at Chicago has cooperated from its beginning with the bureau by presenting one of the most complete programs of market news ever attempted. In addition to daily broadcasts, a series of special talks on marketing by bureau representatives has been used with excellent response from farmers.

There has been a decided movement for various interests to cooperate in a given region and use a single station as the center of agricultural broadcasting. In New England, station WBZ covers practically all of the New England States. In the Northwest station WCCO, sponsored by a committee including representatives of all agricultural interests, presents a strong program for the Northwestern States. In other sections a similar development is in progress.

During the year the use of market reports by State college and university radio stations has been extended. Regular reports have been transmitted by university stations in Ohio, Indiana, Texas, and Iowa and arrangements are being perfected to use the stations in Kansas and Oregon.

Summaries of the regular crop reports have been sent to branch offices for release by radio within a few minutes after they are released at Washington. Through the State crop statisticians local stories have been provided for many stations.

Late in 1924 the first agricultural radio conference was held at Chicago in response to a call issued by the department and representatives of the bureau participated in the discussions. This conference resulted in great increase of interest in radio broadcasting among extension directors and others.

A feature of radio broadcasting developed during the year is the consumer talks which are now distributed weekly in Philadelphia, New York, and Chicago. These consist of description of market conditions and information of supplies of fruits and vegetables which is of value to consumers in determining their purchases for current use and for canning.

ECONOMIC PERIODICALS

Crops and Markets, the principal statistical publication of the department, has been issued during the year

as a weekly, containing current market reviews, movements, and prices, with a monthly issue, the Supplement to Crops and Markets, containing monthly information, such as crop reports, monthly reviews, prices, summaries, etc. The weekly edition now goes to a list of 17,000 names, principally traders and others interested in current market reviews. The supplement is issued in edition of 125,000, and is sent to statisticians, crop reporters, and others desiring a printed record of the important statistical material issued by the bureau from month to month.

The publication of the monthly economic review, The Agricultural Situation, has been continued regularly and it is now distributed to all extension workers and a large number of individuals who are in a position to give further distribution to the information it contains.

State and Federal Marketing Activities, the weekly mimeographed periodical, has been expanded to present a record of economic work in the States, particularly by the agricultural colleges, and to serve as a record of the plans, progress, and changes in personnel throughout the country. This change was made in response to requests of groups of economic workers who have had heretofore no national medium presenting a record of the progress of work. This change has met with wide approval and hearty cooperation by all concerned. The distribution of the periodical has been limited to those doing official work in some way related to the work of the bureau. This periodical is prepared entirely in this division.

Agricultural Cooperation, the semi-monthly review of activity in the field of cooperation; Foreign Crops and Markets, the weekly periodical of foreign information; the Division Letter issued by the Division of Fruits and Vegetables; and the Omnibus for crop estimate statisticians, have been reviewed in the Division of Information for matters of bureau policy.

The B. A. E. News has been issued weekly for circulation only to those on the staff of the bureau to keep them informed of developments and changes in work, to distribute items of importance in administration, and to maintain the highest possible interest and morale throughout the staff. The monthly Library Supplement prepared by the library staff has proved to be a very important addition to this periodical.

REGULAR PUBLICATIONS

During the past year 45 publications have been issued in the various department series after preparation and editing in the editorial section. Twenty-one other publications have been edited and submitted and are in press, and 16 other manuscripts are being edited but have not yet been submitted for publication. Of these manuscripts about 70 are of a technical nature and 12 of a general character.

The editorial standards of the bureau have been steadily improved along lines approved by department editors, and the checking of statistics for form and accuracy has been continued. The bureau editors have in some instances thoroughly revised and rewritten manuscripts and in nearly all cases have advised with authors concerning form and method of presentation.

The bureau editors and writers have given considerable time to reading manuscripts for special articles and to preparing material for addresses by the Secretary, Assistant Secretary, administrative officers of the bureau, and others. During the year 109 special articles relating to the work of the bureau have been edited and accepted for publication in outside periodicals. The bulletin editor alone has written 21 of these special articles.

The preliminary report form of publication, which involves the issuing of small mimeographed editions of material which needs prompt distribution, has continued to expand during the year. Thirty-nine such preliminary reports have been edited and issued. The same care has been used in handling these manuscripts as with those intended for printed publications, and they have served to place information in the hands of those who can use it much quicker than would be the case had the material been held for printing.

The division has supervised the distribution of bureau publications, preparing distribution schemes for 66 new publications during the year. Orders for reprints have also been handled. Miscellaneous requests for bureau publications involve the handling of a large number of letters. The distribution of publications of the International Institute of Agriculture is under the direction of the division, and 13,000 copies of the department Yearbook were also handled. All orders for mimeographing and multi-

special orders, were recorded and transmitted, and over 500 orders for job printing were approved. The mailing lists of the bureau have been checked, new lists established, and changes handled in present lists. There are now 297 special mailing lists for the bureau.

EXHIBITS

During the year the bureau assisted in the preparation of the two principal exhibits of the department—that for the International Livestock Show and that of the National Dairy Show. Special features in each show were prepared by the bureau, such material consisting of 25 to 30 per cent of each of the displays. A number of other exhibits were prepared and material was sent to the department representative in Berlin for showing at the fair in Leipzig, Germany. Representatives of the bureau assisted in handling the cotton exhibit at Waco, Tex., and in the preparation of an exhibit train which was run through the cotton section of the Southwestern States.

When the plan for the preparation of the extension service handbook was adopted, the full time of one worker in the division was devoted to the preparation of economic material for this publication. This has been submitted to the editors of the handbook and will be revised and expanded as new material becomes available.

MOTION PICTURES

Two motion pictures on cooperative marketing were completed during the year, one on cotton and the other on tobacco, each a two-reel film. These films have proven to be very popular with the organizations which have ordered seven duplicates of them.

Plans for several films have been worked upon during the year, but none have been completed for release, and the division has cooperated with other bureaus in completing a number of general films.

CONSUMER DEMAND

Investigations in consumer demand have been continued through the year. Particular attention has been given to the study of consumer demand for meat as a part of the general investigation of methods and practices in retailing meat. Information has been gathered by personal canvass of over 5,000 housewives in 16 cities and preliminary reports were issued in December, 1924, and June, 1925. This

material will be prepared for publication during the ensuing year. Two special consumer-demand surveys were made in Washington, one concerning the importance of brands in marketing butter, and another on the demand for fruits and vegetables.

These consumer-demand studies have met with hearty approval by distributors of the various products, since they provide a type of information which has not heretofore been available. The purpose has been to improve the method and accuracy of the surveys and describe the significance of the results. When considered in connection with information gathered by other methods it is believed they give new light on the question of important changes in demand and how advertising and other influences may be used effectively in maintaining consumer demand.

PHOTOGRAPHY

The work of the photographic laboratory has continued to increase

steadily. There was a slight increase in the quantity of photostat work produced and about 100 per cent increase in general photographic work, including the making of negatives, prints, lantern slides, and enlargements. Some new equipment has been purchased, but the principal handicap has been lack of space for the laboratory. The photographic files are constantly expanding, and during the year a special file of original drawings of charts has been started in space provided by the division. During the year photographers have made several field trips to obtain photographs of crops which have resulted in considerable expansion of our collection of photographs relating to marketing. There has also been an increase in the photographic work of cotton standards, and a considerable volume of work in photographing wool standards. The inauguration of an economic chart service has added considerably to the call upon the laboratory for prints of these charts.



REPORT OF THE LIBRARIAN

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE LIBRARIAN,
Washington, D. C., October 10, 1925.

SIR: I have the honor to submit herewith the report of the library for fiscal year ended June 30, 1925. Though the library was established in 1862, the date of the establishment of the department, no printed reports were issued until 1894. There were also no printed reports for the years 1895 to 1897. Since 1898, reports have been issued annually, the report for the past fiscal year being the twentieth printed report.

Respectfully,

CLARIBEL R. BARNETT,
Librarian.

Hon. W. M. JARDINE,
Secretary of Agriculture.

The library of the department consists of the main library and the branch libraries in the various bureaus and offices of the department. The work of the main library is now organized into four main divisions—the readers' division, the catalogue and order division, the periodical division, and the office of the librarian.

The persons in charge of the different lines of work of the main library were as follows: Miss Emma B. Hawks, associate librarian, in charge of the readers' division, with Miss Corabel Bien as reference assistant and Miss Gertrude E. Upton in charge of the loan desk; Miss Helen M. Thompson, chief of the catalogue and order division, and Miss Katherine G. Upton, assistant chief; Miss Lydia K. Wilkins, chief of the periodical division, and Miss Elizabeth G. Hopper, assistant chief; Miss Ethel E. Smith, secretary to the librarian, in charge of correspondence files and personnel records; and Richard T. Umhau, library accountant. The names of the librarians of the various bureaus and offices are given in the table in Appendix 13, page 18.

LIBRARY SURVEY

This library was one of a few of the Government libraries which were asked to cooperate in the "library survey" recently undertaken by the American Library Association with the hope of producing a worthy contribution to the

semicentennial of the association in 1926. "Its object," in the words of the director of the survey, "is to give honest, fair, unbiased statement of facts, based on actual conditions in library work in America, concerning every phase of library maintenance, administration, and service." The questionnaire contained 185 pages of questions going minutely into the procedure of libraries in the following four main divisions: (1) Library administration; (2) public relations; (3) use and distribution of books; (4) personnel. In view of the large amount of work involved in answering the questions, it was impossible for any member of the staff to devote to the survey sufficient time for the satisfactory answering of the questions. The library, therefore, secured temporarily the services of Miss E. Lucy Ogden, former librarian of the States Relations Service, to undertake the work. Much of the information collected for the survey will be of permanent value to this library and will supplement the special procedure books now maintained by the various divisions of the library and by several of the bureau libraries.

ACCESSIONS

Due to the demands on the library for current books and periodicals, there was less money available this past year for the purchase of old and out-of-print books. Among the more important

and valuable books and periodicals acquired were the following: Buc'hoz, P. J., *Les dons merveilleux et diversément coloriés de la nature dans le règne végétal* (1779-83); Dietze, Karl, *Biologie der eupitheciën* (1910-13); Donaldson, James, *Husbandry anatomized* (1697); Henderson, Peter, *Pomona* (1808); Hübner, J. R., *Sammlung exotischer schmetterlinge*, new English fac-simile edition (1894-1908) and *Zuträge* (1908-12); Malherbe, Alfred, *Monographie des pichées* (1861-62); Martyn, John, *Historia plantarum rariorum* (1752); Robert, Nicolas, *Variae ac multifformes florum species* (1665); Rothschild, L. W. R., baron, *Extinct birds* (1907); Roupell, A. E., *Specimens of the flora of South Africa* (1849); *Neuestes magazin für die liebhaber der entomologie*, hrsg. von D. H. Schneider, 5 parts (1791-1794). Special mention should also be made of two expensive recent natural history books, namely: Frohawk, F. W., *Natural history of British butterflies* (1924); and Seton, E. T., *Lives of game animals* (1925). An important addition to the files of statistical publications was a long set of the *Chicago Daily Trade Bulletin* beginning with 1871. The library now has a complete file from 1871 to date with the exception of the years 1872-75, 1877, 1879-80 and 1892.

An interesting addition to the manuscript material of the library was a collection of old notebooks and letters from the early nursery firm of William Prince & Son, of Flushing, Long Island. A collection of the catalogues of the firm was also obtained, some of them dating as far back as 1818.

Detailed statistics of the volumes, pamphlets, continuations, current periodicals, and maps acquired by purchase, gift, and exchange during the past year are given in Appendices 5 and 7. The library now contains 180,290 accessioned volumes and receives currently 3,314 periodicals.

CATALOGUES AND CATALOGUING

The total number of books and pamphlets fully catalogued by the main library during the year was 13,509. Detailed statistics are given in Appendix 6. In addition to the catalogues maintained by the main library there are a number of extensive catalogues and indexes in the various bureau libraries which were also kept up to date.

PERIODICAL DIVISION

In the past year there has been a change in the organization of the periodical division. Previously the

binding work has been a separate division of the library. In view of the close relationship of this work with that of the periodical division, it has seemed desirable for some time to unite these two branches of the work in one division. The time for doing this seemed propitious during the past year. The change was therefore made on March 1, 1925, the binding work becoming a section of the periodical division. The periodical division as now organized embraces four sections: (1) the current periodical section, which attends to the recording and circulation of the current periodicals received not less than four times a year, (2) the serials section, which records serials the numbers of which are received less than four times a year, (3) the binding section, (4) the acquisition section.

Statistics in regard to the number of periodicals currently received, the number purchased, and the number received by gift and exchange during the past year, the number currently received, arranged by classes, and the number emanating from various countries, are given in Appendices 7 to 9.

BINDING

The statistics of the number of volumes bound in the past 10 years are given in Appendix 10. The amounts spent for binding from 1920 to 1925 are shown in Appendix 11.

DUPLICATES

The lack of assistance for the work made it impossible this past year to devote as much time to the disposition of duplicates, although these demanded attention because of their bulk and the lack of adequate space for storage. A considerable number of state and society publications were returned to the issuing offices. In addition, lists of some of the more important books and periodicals were sent to book dealers, and librarians in the city were asked to look over the collections. The bulk of the duplicates was thus somewhat reduced and the credit received in exchange amounted to \$614.92 as compared with \$954.75 in the previous year.

EXCHANGES AND MAILING LISTS

During the past year 1,295 orders were issued on the Office of Information for the mailing of miscellaneous department publications which were requested by foreign institutions and officials and by societies and private individuals from whom publications are received in exchange. This is a decrease of 959 orders compared with the previous year, owing to the fact that the monthly issuance of the announce-

ments of new department publications was discontinued, the announcements appearing irregularly and not oftener than once in two months. This decrease in the number of requests does not mean that fewer publications were sent out, as the announcements in the new form listed more publications than the regular monthly lists contained and the institutions which selected from the announcements in the new form naturally selected a larger number of publications, as they had more from which to make selections.

The care of the mailing lists filed in the main library, the ordering of the publications sent in exchange to addresses on the lists and in answer to specific requests, and the correspondence involved in the work require a very considerable amount of time. The procedure in the past in connection with this work has required the bureaus to send all additions and changes in the lists to the library for revision before transmitting them to the Office of Information for the cutting of stencils on addressograph plates. On account of the reduction in the library staff in the past year it has been necessary to reduce the routine work of the library wherever possible. Therefore in April of this year an amendment to the Administrative Regulations was made at the suggestion of the library whereby the changes and additions are sent by the bureaus direct to the Office of Information, which attends to the making of the addressograph plates. Copies of the addresses on cards are then sent by the Office of Information to the library to be incorporated in the various mailing lists for use in obtaining exchanges. The elimination of the one step in the procedure, namely, the revision by the library of the addresses, has resulted in a considerable saving of time for the library. The responsibility for the correctness and form of the addresses now rests with the offices to which the lists belong.

USE OF THE LIBRARY

Detailed statistics of circulation are given in Appendices 1 to 4, but some explanation of the figures is needed.

The total number of books recorded as circulated by the main library and the bureau libraries was 92,263. No records of the reference use are kept either in the main library or the bureau libraries. The totals of the recorded circulation of current periodicals are not given. These totals would be more misleading than informing in view of the fact that some of the bureau libraries having a large circulation of current periodicals, notably the Bureau

of Agricultural Economics and the Office of Experiment Stations, keep no circulation statistics. The main library also keeps no records of the circulation of current periodicals, since the bulk of its circulation is to the bureau libraries which send the periodicals directly to the readers. The circulation figures as given represent, therefore, only approximately the total use of the library.

BIBLIOGRAPHICAL WORK

Two additions, No. 8 and No. 9, were made in the past year to the mimeographed series of the "Bibliographical contributions of the library of the department." No. 8, entitled "Index of the Publications of the United States Department of Agriculture on the Subject of Plant Pathology," was prepared in the Bureau of Plant Industry library by the librarian, Miss Jessie M. Allen, and consists of 158 pages. No. 9, entitled "World Food Supply," was prepared in the Bureau of Agricultural Economics library, by the assistant librarian, Miss Margaret T. Olcott, and consists of 68 pages.

In the Bureau of Agricultural Economics library the most important single bibliography issued during the year was that entitled "World Food Supply," mentioned in the previous paragraph. The bibliography entitled "The Marketing of Agricultural Products" issued last year in mimeographed form, was so well received that it was decided by the bureau to add a section on the "Marketing of Seed" and to issue it as Miscellaneous Circular 35 of the United States Department of Agriculture. This additional section was compiled by Miss Emily L. Day and the printed circular appeared in March, 1925. The original bibliography in mimeographed form received honorable mention by the Eunice Rockwood Oberly memorial fund committee of the American Library Association as being second in importance of those submitted for the award given by that committee in December, 1924.

The monthly Library Supplement to the B. A. E. News formerly carried in each issue a selected bibliography. At the suggestion of the director of information of the Bureau of Agricultural Economics, it was decided to omit the bibliographies from it and confine the Library Supplement more closely to library news, in the form of book and periodical reviews and descriptions of the work of the bureau library. At the same time it was decided to begin a new numbered mimeographed series for the bureau called "Agricultural Economics Bibliographies." This series

was begun in January, 1925, and the following bibliographies have appeared in it to date: No. 1, Agricultural economics; No. 2, Flour milling and bread making; No. 3, A beginning of bibliography on the literature of rural life; No. 4, Price spreads; No. 5, Long-time agricultural programs, national, regional and State. The series is designed to include not only the bibliographies compiled in the Bureau of Agricultural Economics library, but any others which may be made in any of the divisions of the bureau. During the six months, July to December, 1924, before the change in the character of the Library Supplement of the B. A. E. News was made, there were published in it the following bibliographies: "Business and agriculture" (Library Supplement No. 13); "Current serials containing material relating to agricultural economics issued by State departments of agriculture, agricultural experiment stations, and State universities" (Library Supplement No. 14); "State crop and livestock reports issued in cooperation with the United States Bureau of Agricultural Economics" (Library Supplement No. 15); "Cost of production of sugar; a bibliography on the cost of producing sugar beets, sugar cane, and raw cane sugar" (Library Supplement No. 16); "International trade" (Library Supplement No. 18). The verifying of the bibliographies and footnotes appearing in the bulletins and mimeographed reports of the Bureau of Agricultural Economics was undertaken by the library of the bureau in October, 1924. This work was formerly done in the editorial office of the bureau. Verifications for ten manuscripts were made up to the close of the fiscal year.

In the Bureau of Chemistry library the librarian has completed an annotated bibliography entitled "Books to Humanize Chemistry," consisting of 183 titles. The library has also continued to issue monthly a mimeographed list of patent specifications received by the library.

In the Bureau of Entomology library the time of the librarian from January to June was largely devoted to the compilation of the new volume of the printed Index to the Literature of American Economic Entomology. This volume, which has recently been published, covers the years 1920 to 1924 and contains between 300 and 400 pages. In addition to this extensive piece of bibliographical work, the Bureau of Entomology library prepared a number of short bibliographies, continued the card index to publications of the bureau, and prepared each week for

inclusion in the Official Record the list of articles by members of the bureau which appeared in publications outside of the department.

The Office of Experiment Stations library has prepared the second biennial supplement to Bulletin 1199 of the United States Department of Agriculture entitled "List of Bulletins of the Agricultural Experiment Stations from their Establishment to the End of 1920." This second supplement covers the years 1923 and 1924 and will soon be ready for the press. The delay in issuing the list has been due to the failure to receive promptly the station bulletins which were published during the interim covered by the supplement. A "Partial Index to Proceedings of the Association of American Agricultural Colleges and Experiment Stations and the Association of Land-Grant Colleges, 1885-1923, with Special Reference to Agricultural Education and Research," was prepared and presented by A. C. True as the bibliographer's report of the association. The library continued to prepare the mimeographed monthly list of the agricultural extension publications of the various States.

In the Forest Service library the bibliographies on "Douglas Fir" and on "Forest Taxation" have been brought up to date and remimeographed for distribution. A number of new bibliographies have been prepared, the most important of which were the following: "Forest Fire Insurance," "Form and Taper of Trees," "Preparation of Volume Tables," "Prevention of and Fighting Forest Fires," "Selected Articles on Plant Breeding," "Technique of Volume and Growth Studies," and "White Pine." As in the past, the monthly list of books and bulletins indexed in the Forest Service library is published in the Journal of Forestry.

The Bureau of Home Economics library completed a bibliography of 18 typewritten pages on school lunches. Work has been begun in preparing one section of the meat bibliography which has been undertaken by a committee of the department. The phases of the subject in which material is being gathered in the Bureau of Home Economics are the composition and chemical analysis of meat, cooking of meat, and the nutritive value of meat.

Instead of issuing a reprint or new edition of the "Checklist of the Publications of the Department of Agriculture on the Subject of Plant Pathology, 1837-1918" (United States Department of Agriculture Library, Bibliographical Contribution No. 1), which

was issued in 1919 and the supply of which is exhausted, the librarian of the Bureau of Plant Industry decided to issue an author and subject index covering the publications of the department on plant pathology up to January 1, 1925. As previously noted, this was issued as United States Department of Agriculture Library Bibliographical Contribution No. 8. It largely supersedes No. 1 of the series, though in a different form. Although designated as an "index," it is in fact an abbreviated list of the literature, arranged by author and subject, with many cross references from joint authors and related subjects.

The verifying and editing of citations to literature in the manuscripts for both the Bureau of Plant Industry publications and the Journal of Agricultural Research has for a number of years been an important part of the bibliographical work of the Bureau of Plant Industry library. The bibliographies and citations in 154 manuscripts were verified during the past year. On January 16, 1925, the verifying and editing of citations in the Journal of Agricultural Research was transferred to the Office of Information of the department as the result of the transfer of the editing of the Journal of Agricultural Research to that office, in accordance with Department Memorandum No. 512. One of the library assistants in the Bureau of Plant Industry library, who handled part of the citation work of the Journal of Agricultural Research, was transferred at about the same time to the Office of Information to carry on the same work. She, however, continues to have her desk in the main library, as it is more convenient to do the work there, and it also saves the work of the main library in charging the books and periodicals needed in the verification of the references cited. This arrangement will probably be continued as long as the main library can spare the desk space for the assistant. Previous to the transfer of the Journal of Agricultural Research to the Office of Information, the Bureau of Plant Industry library, in connection with the verification of citations to literature in the Journal, prepared a set of instructions entitled "Suggested Procedure for Citations to Literature in the Journal of Agricultural Research." This was mimeographed early in the year and distributed to authors and editors in the department and at the State experiment stations who are concerned with preparation of manuscript.

The current indexing of botanical literature carried on by the Bureau of Plant Industry library with the coop-

eration of the Office of Economic and Systematic Botany has been continued and the volume of the work has increased. The title of the mimeographed list of botanical articles in current journals and books which has been issued bi-weekly for several as "Current Author Entries" was changed in January, 1925, to "Current Botanical Literature." The various lists for the past year averaged 22 pages each as compared with 20 pages for the previous year. The lists are prepared by Miss Alice C. Atwood, bibliographical assistant of the Bureau of Plant Industry, and her assistant, Miss Esther M. Colvin. The circulation of this list increases each year. It is one of the most important features of the work of the Bureau of Plant Industry library, as it brings promptly to the attention of scientific workers all the important literature of botany and plant pathology available in the library.

The Bureau of Public Roads library has continued to issue each week the mimeographed list of articles in current periodicals of interest to the bureau. To the lists is appended a list of new accessions in the bureau library. The bibliography relating to soil alkalies, compiled under the direction of Samuel H. McCrory, of the Bureau of Public Roads, was issued as Department Bulletin No. 1314. The librarian of the bureau assisted in the work. The library has joined in the cooperative undertakings of the bureau with outside organizations, notably in the case of the Highway Research Board of the National Research Council. Some time ago a bibliography on gravel roads was compiled at the request of the board. At present the library is furnishing references to be used in connection with the board's study of earth roads.

The bibliographical work of the main library was confined to the preparation of short lists and the answering of bibliographical queries in response to requests received in correspondence.

BUREAU AND DIVISION LIBRARIES

A list of the bureau and office libraries with statistical data in regard to them and the names of the librarians will be found on page 18, Appendix 13. An account of their bibliographical work is given under the heading "Bibliographical work," on page 3. The statistics of the circulation in the bureau libraries are given in the table, Appendix 1.

WORK OF THE PAST YEAR

The most outstanding event of the past year in connection with the bu-

reau libraries was the addition of a new unit, the Bureau of Dairying library, the agricultural appropriation act for 1925 having provided for the separation of the Dairy Division from the Bureau of Animal Industry and the raising of it to the rank of a bureau. There is, therefore, again a separate dairying library. The history of this library is of interest as an example of the changes which are likely to take place from year to year, in connection with the bureau libraries, affected as they are by changes in bureau organization, changes of location of offices, and the development of the work of the bureaus. While the Dairy Division was still a part of the Bureau of Animal Industry, back as far as 1908, it felt the need of a separate library. A library was, therefore, established with a librarian in charge and one clerical assistant. The Dairy Division was then located in a rented building at 1358 B Street SW., on the site now occupied by the Bieber Building, in which the main library is located. Considerable material had been previously collected by the various workers of the division for the new library. This was brought together, catalogued and made available for the whole division. The following year the Dairy Division library with the division were moved to the fourth floor of the east wing of the newly built laboratory buildings of the department. A separate Dairy Division library was maintained in this location until 1920, when a reorganization of the library activities of the Bureau of Animal Industry took place, the librarian of the Dairy Division having been appointed librarian of the Bureau of Animal Industry and given authority to merge the Dairy Division library with the library work of the other offices of the bureau, excepting only the Animal Husbandry Division, which was housed in uptown offices some distance from the main offices and laboratories of the bureau. For a few years previously there had been no librarian of the Bureau of Animal Industry as a whole, the collections originally maintained by the bureau, with the exception of those of the Dairy Division, having been merged with those of the main library in March, 1908, when the Bureau of Animal Industry and the library of the department were both moved to the east wing of the new laboratory buildings. When the Bureau of Animal Industry library was created in 1920, the books, catalogue, and furniture of the Dairy Division were moved to the new rooms set aside for the bureau library on the

second floor. The bureau library also took over the card index of veterinary literature which had been a project of the Bureau of Animal Industry for a number of years. This arrangement continued until July, 1924, when the new Bureau of Dairying was created. The two libraries, however, continued to be operated jointly in the old location until October, 1924, when new quarters and equipment in the basement of the east wing were set aside for the library of the Bureau of Dairying. The final separation of the work of the two libraries did not take place until February, 1925.

Previous to 1920, when the Dairy Division library was maintained separately, it had charge of the photographs and slides and the correspondence files of the division. When it was merged with the Bureau of Animal Industry library, it was relieved of the supervision of these files. In the fall of 1924, after the reorganization of the Bureau of Dairying library, they were again placed under the library's charge. Two new assistants were appointed to look after these files and to assist in the circulation of the periodicals.

The library of the Bureau of Agricultural Economics is the economics branch of the department library. It consists of the statistical collections relating to acreage, production, prices, etc., of agricultural crops as well as the collections on economics, cooperation, marketing, rural economics, land and rent, labor and wages, finance and commerce. It is believed to be the strongest collection of agricultural statistics in this country. In order to make the collection of more value, the library of the bureau has been engaged for a little more than a year in the compilation of data for a series of "source books" showing the official sources of various types of agricultural statistics of European countries. To date the statistics from 47 official publications have been analyzed and nearly 7,000 cards made.

The crowded condition of the Bureau of Entomology library was relieved during the past year by the assignment of an additional room for its use. The library equipment was improved by the installation of new steel shelving in place of the old wooden shelving. New floors were also laid and the walls painted. The rooms are now much improved in appearance and in convenience of arrangement. While the improvements were in progress the regular routine work went on as usual, but the library was in a more or less unsettled condition for several weeks, which interfered to some extent with

its use. As a consequence, the circulation for the year was not quite as large as that of last year. The increased work of the library has made it necessary to add another assistant to the staff. The greater part of the librarian's time for the last half of the year was devoted to the preparation of the new volume of the Index to the Literature of American Economic Entomology.

In October, 1924, the Bureau of Home Economics was moved to one of the temporary buildings built by the Government during the war as a hotel for women. This necessarily resulted in important changes to the library of the bureau. Previously, the library had been much crowded, but with the removal to new quarters it was assigned three pleasant rooms on the first floor near the administrative offices of the bureau. The distance of the new quarters of the Bureau of Home Economics from the main library made it necessary for it to have in its library a much larger collection of books. Previously its collection was small, as it was in close proximity to the main library and was able to make use of all its reference collection and bibliographical tools. The duplication of books necessary as a result of this change is an illustration of the added expense of the library due to the present scattered housing facilities of the department.

The libraries of the Bureau of Chemistry, the Office of Experiment Stations, the Forest Service, the Bureau of Plant Industry, and the Bureau of Public Roads report no marked changes or developments in their work during the past year. In the Bureau of Chemistry and the Forest Service there was a considerable increase in the circulation of both books and periodicals.

LIBRARY STAFF

The library staff suffered a severe loss in the death of Miss Mabel Nye, who had served as librarian of the Bureau of Home Economics since the establishment of the bureau in July, 1923. For several years previously she had been the bibliographical assistant of the Office of Home Economics while that office was a part of the States Relations Service. The position of librarian of the Bureau of Home Economics made vacant by Miss Nye's death was filled by the appointment of Mrs. Eva T. Shively, formerly an assistant in the Bureau of Agricultural Economics library.

The position of librarian of the Bureau of Dairying newly established in July, 1924, was filled by the transfer of Miss Carrie B. Sherfy, librarian of

the Bureau of Animal Industry, who previous to her service in that position had been librarian of the Dairy Division. The position of librarian of the Bureau of Animal Industry was filled by the appointment of Miss Florence M. Thompson, formerly assistant reference librarian of the main library, who had specialized in the subjects of interest to the Bureau of Animal Industry.

The new position added to the staff of the library of the Bureau of Entomology was filled by the transfer of one of the library assistants in the Office of Experiment Stations library.

Of the five assistants who left the main library during the past year, four were library assistants and one a clerical assistant. Of the four library assistants one resigned on account of ill health, one was transferred to the Bureau of Plant Industry, one resigned to enter college, and the fourth was transferred to the Forest Products Laboratory of the Forest Service at an increased salary. The clerical assistant resigned to accept a position outside of the Government service at a higher salary.

The number of employees carried on the main library staff at the close of the fiscal year was 36. Of this number two were temporary employees, the appointment of one of whom terminated on June 30. The number employed by the bureau and office libraries was 52. The total number of employees in the main library and the bureau and office libraries was 88. Of these, 14 were in administrative positions, including the librarian of the department, the heads of divisions in the main library, and the librarians of the bureaus; 35 were assistant librarians, junior librarians, library assistants, and junior library assistants; 12 were under and minor library assistants; 1 was a translator; 12 were clerical assistants; 11 were messengers; and 3 were charwomen. Although the total number of the library staff this past year, namely, 88, was the same as last year, the number was distributed differently; the number in the main library this year being 36 as compared with 40 last year, and the number in the bureau libraries this year being 52 as compared with 48 last year. The decrease in the main library was due to the library's reduced appropriation.

That there were fewer changes in the staff of the main library and the bureau libraries in the past year is believed to be due directly to the better salaries received under the new classification act.

Staff meetings, including the affairs of both the main library and the bureau libraries, were held monthly from October to June.

APPENDIX 1

Combined statistics of circulation

Bureau	Number of books charged						Number of periodicals charged	
	To individuals		To main library		To branch libraries			
	1924	1925	1924	1925	1924	1925	1924	1925
Main library	21,044	23,798			24,501	27,064		(1)
Bureau of Agricultural Economics	15,255	14,634	1,501	1,010	(1)		45,545	51,462
Bureau of Animal Industry ²	4,163	2,425	2,271	216			16,276	15,644
Bureau of Chemistry	7,983	8,053	710	856	133	77	24,434	2,641
Bureau of Dairying	(2)	1,842	(2)	76	(2)	(1)	8,826	8,986
Bureau of Entomology	3,815	2,726	385	336	61	31	(2)	1,918
Office of Experiment Stations ³							4,261	3,286
Forest Service	2,245	2,284	433	484	9	7		
Bureau of Home Economics	(4)	(1)	(4)	(4)	(4)	(1)	2,087	2,775
Bureau of Plant Industry	(7)	(7)	(7)	(7)	(7)	(7)	(4)	2,241
Bureau of Public Roads	3,434	3,177	85	133			3,519	3,310
Total	57,939	58,939	2,935	3,111	24,704	27,779		
				</				

¹ No record of the circulation of periodicals is kept in the main library for the whole year, but is kept for one month each year.

² The Dairy Division of the Bureau of Animal Industry was made a separate bureau on July 1, 1924. The statistics of circulation for the Dairy Division in the fiscal year 1924 were included with those for the Bureau of Animal Industry.

³ No circulation figures are available for the Office of Experiment Stations. The circulation is, however, large, as the office, in connection with the work on the Experiment Station Record, receives all new books and periodicals which are needed for review and abstracting; 950 periodicals are regularly circulated and many more specially requested. The circulation is estimated to be not less than 50,000.

⁴ Figures not available.

⁵ Figures for eight months.

⁶ Approximate figures.

⁷ The Bureau of Plant Industry library does not maintain a collection of books as it is in close proximity to the main library. The circulation of books to members of the bureau is therefore included with those for the main library, but circulation figures are available for current periodicals, as this circulation is handled in the Bureau of Plant Industry library.

APPENDIX 2

Circulation statistics of the main Library, by months and years, for the fiscal years 1906 to 1925

Month	1905-06	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19	1919-20	1920-21	1921-22	1922-23	1923-24	1924-25
July.....	988	1,078	1,375	1,642	2,490	2,357	2,397	2,472	2,651	3,019	3,077	2,932	3,113	2,860	2,687	2,827	3,081	3,017	3,066	3,204
August.....	1,170	1,378	1,446	1,455	2,334	2,381	2,425	2,269	2,083	2,567	3,285	2,883	3,027	2,616	3,216	2,807	3,152	2,959	2,920	3,078
September.....	1,210	1,088	1,270	1,893	2,540	2,259	2,517	2,584	2,531	2,793	3,334	2,935	2,968	2,232	2,678	2,790	2,806	3,044	2,922	3,070
October.....	1,436	1,789	1,789	2,714	2,610	3,118	3,404	3,048	3,303	3,903	4,183	4,421	3,617	2,474	3,444	3,101	3,845	4,219	3,688	4,671
November.....	1,782	1,599	2,051	2,406	3,567	3,083	3,465	3,152	3,232	3,352	4,439	4,409	4,462	2,684	2,484	3,381	3,650	4,576	3,817	4,777
December.....	1,381	1,832	1,918	2,682	3,315	2,952	2,962	3,051	3,226	4,150	4,140	3,797	3,137	2,728	2,897	3,369	3,448	4,084	3,346	5,325
January.....	1,645	2,005	2,061	3,061	3,354	3,535	4,094	4,106	4,454	5,260	4,888	4,839	4,099	3,572	3,668	3,932	3,749	4,357	4,613	5,255
February.....	1,933	1,715	2,380	2,798	3,221	3,340	3,851	4,103	3,618	4,003	4,715	4,625	3,693	3,820	3,346	3,481	3,773	4,443	4,923	5,037
March.....	1,895	1,894	1,969	3,000	3,310	3,698	3,614	3,415	4,021	5,080	5,028	4,640	3,676	3,920	3,480	4,481	4,861	4,063	4,732	4,546
April.....	1,634	1,885	1,699	3,169	2,804	3,805	3,415	3,394	3,623	3,514	4,032	3,766	3,444	3,608	3,497	4,444	3,239	3,826	4,265	4,759
May.....	1,524	1,604	1,981	2,913	2,708	2,389	3,208	3,148	3,951	3,072	3,416	3,137	3,326	3,327	3,103	3,326	3,319	3,716	4,224	4,106
June.....	1,468	1,322	2,001	2,873	2,917	3,163	2,760	2,891	3,188	3,285	3,637	3,476	2,770	2,606	3,085	3,483	3,691	3,172	3,587	3,634
Year.....	18,066	18,994	22,470	30,606	35,180	36,250	38,112	36,933	38,879	40,953	48,914	46,339	40,447	36,457	38,301	40,841	42,894	46,078	45,545	51,462

LIBRARY

APPENDIX 3

INTERLIBRARY LOANS

Record of books lent outside of Washington during the fiscal years 1906 to 1925

States, etc.	1906 ¹	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Alabama.....	7	1	18	13	11	8	8	7	3	3	14	10	7	4	10	17	5	6	8	3
Arizona.....	31	6	1	1	1	2	15	19	27	26	50	38	13	5	19	32	21	1	11	20
Arkansas.....	10	6	1	1	10	8	8	15	12	27	24	16	7	9	10	18	18	29	24	20
California.....	4	2	7	7	4	7	15	19	12	27	24	22	2	5	10	13	5	18	52	47
Colorado.....	32	15	10	10	41	11	12	16	4	4	2	2	2	5	1	7	13	37	13	9
Connecticut.....	13	1	56	81	54	36	38	11	18	11	10	6	17	11	30	21	28	35	10	48
Delaware.....	13	1	1	1	7	4	7	7	14	15	37	24	5	4	7	12	31	15	14	103
Florida.....	13	1	1	1	7	4	7	7	14	15	37	24	5	4	7	12	31	15	14	84
Georgia.....	13	1	1	1	7	4	7	7	14	15	37	24	5	4	7	12	31	15	14	13
Idaho.....	13	1	1	1	7	4	7	7	14	15	37	24	5	4	7	12	31	15	14	31
Illinois.....	13	1	1	1	7	4	7	7	14	15	37	24	5	4	7	12	31	15	14	4
Indiana.....	9	7	2	2	16	11	2	6	12	7	66	30	44	49	23	20	17	13	6	25
Iowa.....	9	7	2	2	15	15	23	7	7	25	20	13	11	4	13	38	7	32	24	23
Kansas.....	1	1	1	1	6	13	9	36	24	63	80	40	52	15	22	72	59	69	82	76
Kentucky.....	1	1	1	1	2	2	18	8	12	59	71	38	31	41	22	3	23	15	14	18
.....	1	1	1	1	3	11	2	6	4	25	7	4	8	13	15	13	30	34	49	23

¹ Separate figures for the various States were not kept in this year.

Record of books lent outside of Washington during the fiscal years 1906 to 1925—Continued

States, etc.	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Louisiana.....					13	2		5	2	2	10	8	21	9	5	5	15	15	10	13
Maine.....		9	8	12	9	25	4	7	11	8	22	16	10	2	3	1	17	1	12	8
Maryland.....		1	7	17	8	8	9	12	7	25	28	48	30	10	21	24	34	66	117	65
Massachusetts.....		11	35	3	8	17	10	14	18	36	25	33	22	10	37	16	24	37	30	62
Michigan.....		5	4	7	8	6	20	37	35	22	37	38	21	9	17	50	34	41	44	39
Minnesota.....		1	11	9	8	5	5	2	7	64	78	50	44	63	89	88	44	60	59	70
Mississippi.....				2	1	8	3	4	3	4		1	1	1		4	2	2	5	1
Missouri.....		7	7	4	4	1	5	17	19	18	15	19	37	2	10	6	22	31	30	37
Montana.....				1	3	2	2	15	13	5	15	19	10	17	13	7	6	28	26	17
Nebraska.....			6	12	18	41	17	32	20	20		10	4		15	7	7	14	10	25
Nevada.....		1									3	1	1		1		2	1		
New Hampshire.....			4	3				8	5	3	2	8	10	7	49	89	11	22	12	6
New Jersey.....				3	2	1		1	24	83	53	76	28	6	6	6	63	107	75	92
New Mexico.....								1	4	3	9	8	6	47	11		11	1		2
New York.....		21	55	53	91	70	79	59	113	142	127	148	103	66	85	81	117	101	136	149
North Carolina.....		2	24	18	38	38	25	35	30	48	17	13	7	1	6	26	43	27	48	61
North Dakota.....			3		2	18	4	6	11	3	11	3	6	6	3	14	10	8	13	10
Ohio.....		15	4	17	13	29	37	53	103	78	29	41	56	9	30	32	35	32	89	86
Oklahoma.....								3	1						1	7	8	5	1	13
Oregon.....			9	1	24	38	36	54	44	51	66	51	73	5	19	53	30	15	6	8
Pennsylvania.....		4	18	33	4	3	27	34	19	21	29	19	21	10	30	51	37	35	60	75
Rhode Island.....					1					6	2	17	4	2	12	5	8		1	15
South Carolina.....				3		1	2	5	1	1	22	27	14	2		12	11	15	22	20
South Dakota.....															3		3		1	1
Tennessee.....		4	5	3	9	13	9	16	26	23	31	22	19	11	11	11	12	33	8	8
Texas.....		5	4	1	12	13	12	10	9	20	11	38	8	9	4	21	14	19	19	3
Utah.....										8	17	16	3	8	14	19	22	12	45	28
Vermont.....		8	4	16	14	8		27	30	21	9	3	3	3	3	7	12	11	20	14
Virginia.....		1	13	28	28	15	50	52	54	32	26	18	4	10	19	46	28	38	40	52
Washington.....		4	9	1	6		13	3	14	8	11	2	8	4	12	31	4	7	17	22
West Virginia.....					2	1	14	10	2	12	16	8	19	19	10	13	15	13	15	16
Wisconsin.....		3	13	9	4	37	32	89	31	38	41	34	36	62	2	48	63	35	33	88
Wyoming.....		4		1	6	7		5		4	5	3		6	4	6	11	3	7	21
Cuba.....										2							1			
Hawaii.....		5	11	14	3	7	1	2	2	57	43	39	28	1	14	32	9	9	20	1
Porto Rico.....			1	2	52	55	33	39	67					2	1		1			17
Island of Guam.....											2				1					
Alaska.....			2						1											
Panama.....				2	1	4	11													
Foreign countries.....								2												
Total.....																				
Photostat copies of articles.....										1,196	1,240	1,093	893	658	799	1,139	1,015	1,193	1,505	1,087
Typewritten copies of articles.....										101	129	108	84	145	142	78	126	189	180	206
										12	9	12	11		17	11	7	8	10	26
	138	248	391	416	548	613	620	836	895	1,309	1,378	1,273	988	803	958	1,228	1,148	1,290	1,695	1,919

APPENDIX 4

Summarized statement of books borrowed from other libraries during the fiscal years 1916 to 1925

Library from which borrowed	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Library of Congress.....	5,279	4,629	3,567	4,126	3,385	3,290	3,180	2,953	3,172	3,653
Surgeon General's library.....	939	962	878	607	476	470	511	364	441	479
Smithsonian Institution and National Museum.....	227	141	124	110	75	100	68	55	90	99
Geological Survey.....	92	57	49	64	73	61	69	50	78	87
Patent Office.....	29	49	25	36	18	20	40	41	44	31
Bureau of Education.....	43	41	4	11	4	21	22	9	15	7
Public Library.....	33	11	13	21	10	18	39	56	28	31
Hygienic Laboratory.....	45	21	15	12	12	3	28	10	20	9
Bureau of Standards.....	2	7	2	2	6	8	17	11	41	23
Other libraries in Washington.....	85	92	40	37	62	86	54	46	73	101
Total from libraries in Washington.....	6,774	6,010	4,717	5,026	4,121	4,077	4,028	3,595	4,002	4,520
Libraries outside of Washington.....	86	82	35	70	39	58	69	53	46	77
Grand total borrowed from other libraries.....	6,860	6,092	4,752	5,096	4,160	4,135	4,097	3,648	4,048	4,597
Largest number borrowed on any day.....	42	41	46	41	30	60	35	37	42	49
Average number borrowed daily.....	23	16	15	16	13	13	13	11	13	15
Largest number borrowed in any month.....	734	623	481	613	458	480	436	431	469	481
Average number borrowed monthly.....	571	507	396	424	346	344	341	304	337	383

APPENDIX 5

Accessions to the library for the fiscal years 1916 to 1925

Accessions	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Purchases:										
Volumes.....	1,595	1,949	1,510	1,373	1,989	1,420	1,384	2,040	2,320	1,945
Pamphlets.....	49	76	79	88	119	47	81	94	123	54
Maps and charts.....	13	1	4	2	6	3	9	13	68	5
Serials and continuations.....	274	147	97	154	187	456	464	300	436	623
Total.....	1,931	2,173	1,690	1,617	2,301	1,926	1,938	2,447	2,947	2,627
Gifts:										
Volumes.....	873	641	676	647	768	774	934	720	1,029	1,151
Pamphlets.....	397	508	642	371	580	492	751	847	1,022	734
Maps and charts.....	18	4	59	15	21	10	59	15	39	14
Continuations.....	4,919	4,458	3,807	2,647	4,762	3,515	5,683	3,684	5,534	4,827
Total.....	6,207	5,611	5,184	3,680	6,131	4,791	7,427	5,266	7,624	6,726
From binding periodicals and serials.....	1,612	1,178	949	748	1,161	768	1,305	1,545	2,128	2,293
From lacing periodicals in binders.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	21,800	1,618
Total.....	9,750	8,962	7,823	6,045	9,593	7,485	10,670	9,258	14,499	13,264

¹ Figures not available.

² Record kept for 6 months; 6 months estimated.

According to the record of accessions the total number of books and pamphlets accessioned by the library up to July 1, 1925, was 187,032. From this number should be taken 5,910, which were discarded during the fiscal year 1915, and 832, which have been discarded since that time, leaving a balance of 180,290 accessioned volumes and pamphlets in the library on July 1, 1925.

APPENDIX 6

CATALOGUING

The record of the material catalogued during the past five years is as follows:

	1920	1921	1922	1923	1924	1925
Volumes.....	2,757	2,194	2,318	2,760	3,349	3,096
Pamphlets.....	699	539	832	941	1,145	788
Maps.....	27	13	68	28	107	19
Serials and continuations ¹	6,110	4,739	7,452	5,529	9,898	9,361
Entries for current periodicals ²					221	245
Total.....	9,593	7,485	10,670	9,258	14,720	13,509
Pamphlets ³	501	96	229	87	103	165
"Reprints" ⁴	1,937	4,828	2,745	1,502	1,491	3,088

¹ The figures for 1923 differ from those given in the printed report for 1923, since due to an oversight the 1,545 volumes received from the bindery were not included. The number of serials and continuations catalogued should therefore have been 5,529 instead of 3,984, as was given, and the total number of pieces catalogued should have been 9,258 instead of 7,713.

Previous to 1924 no record was kept of the cataloguing of volumes of periodicals in temporary binders. In the figures for 1924 these have been included. An exact record was kept for six months during which period the number catalogued was 977. The number catalogued for the whole year was therefore estimated to be 1,800. This accounts in part for the large increase over 1923 in the number of serials and continuations catalogued.

² No record kept previous to 1924.

³ Not fully catalogued.

⁴ Author cards only.

Uncatalogued material

	1921	1922	1923	1924	1925
Volumes.....	290	543	1,262	847	1,132
Pamphlets.....	1,085	1,905	798	3,516	3,941
Continuations.....	1,105	846	1,541	921	1,653
Maps.....		19	43	35	36

Number of titles prepared for printing by the Library of Congress in the "Agr." series

	1921	1922	1923	1924	1925
Cards for accessions and recatalogued books.....	1,097	786	599	805	755
Cards for department publications.....	627	369	381	432	399
Cards for foreign agricultural periodicals.....			263	152	55
Total.....	1,724	1,155	1,243	1,389	1,209

¹ The number of cards received from the Library of Congress was considerably less than the number sent as the printing of the cards by the Library of Congress has been hampered by lack of funds. At the close of the fiscal year there were, moreover, 772 manuscript cards waiting to be sent to the Library of Congress, to be printed because of the inability of the Library of Congress to keep pace with the preparation of the cards.

Record of cards added to the catalogue

	1921	1922	1923	1924	1925
Number of cards added.....	23,730	17,148	24,728	20,861	21,281
Number of cards withdrawn.....	4,224	1,739	2,752	2,389	² 24,763
Net addition to catalogue.....	19,506	15,409	21,976	18,463	(³)

² Of the 24,763 cards withdrawn, 22,435 were printed Botanical Supply Co. index cards which were withdrawn because they duplicate entries in the "Botanical Catalogue" now in close proximity to the main catalogue. The cards withdrawn were index entries for botanical articles in periodicals.

³ The number of cards withdrawn was 2,323 more than the number added.

APPENDIX 7

PERIODICALS

Number of different periodicals currently received by purchase.....	1,023
Number of different periodicals currently received by gift and exchange.....	2,291
Total number of different periodicals received.....	3,314
Number of additional copies purchased.....	192
Number of additional copies received by gift and exchange.....	230
Total number of periodicals purchased, including duplicates.....	1,215
Total number of periodicals received by gift and exchange, including duplicates.....	2,521
Grand total of periodicals received currently, including duplicates.....	3,736

APPENDIX 8

The number of current periodicals received, arranged by classes, is shown in the following table:

Statistics of current periodicals

Class	Pur- chase	Gift	Total	Class	Pur- chase	Gift	Total
Agriculture, United States...	16	157	173	Flour and feeding stuffs, etc..	12	9	21
Agriculture, foreign.....	41	280	321	Ice and refrigeration.....	5	5	10
Veterinary medicine.....	28	51	79	Paper.....	15	7	22
Dairying.....	19	36	55	Printing.....	4	1	5
Poultry and pigeons.....	4	38	42	Photography.....	8	2	10
Livestock and meat trade.....	11	81	92	Physics.....	15	4	19
Soils and fertilizers.....	5	6	11	Meteorology.....	1	1	2
Drainage and irrigation.....	2	1	3	Chemistry and chemical tech- nology.....	86	44	130
Farm implements and ma- chinery.....	8	8	16	Food.....	11	32	43
Moor culture and peat.....	3	3	6	Home economics.....	11	2	13
Agricultural products.....	16	98	114	Pharmacy.....	18	22	40
Fibers and textiles.....	9	11	20	Geology and mineralogy.....	1	3	4
Horticulture and landscape gardening.....	50	85	135	Natural history.....	26	38	64
Forestry.....	21	65	86	Zoology.....	11	19	30
Experiment station publica- tions (United States).....		98	98	Hunting and fishing.....	5	14	19
Experiment station publica- tions (foreign).....	4	22	26	Ornithology.....	14	21	35
General.....	15	20	35	Entomology.....	48	29	77
Bibliography and library economy.....	21	17	38	Beekeeping.....	23	12	35
Education, including agri- cultural extension.....	5	163	168	Microscopy.....	4	1	5
Economics and sociology.....	48	139	187	Biology.....	21	18	39
Commerce and statistics.....	72	293	365	Medicine, physiology, and hygiene.....	79	51	130
Groceries.....	5	14	19	Bacteriology.....	8	5	13
Engineering.....	38	26	64	Botany.....	55	43	98
Building.....	9	4	13	General science.....	49	37	86
Roads.....	9	57	66	Geography.....	2	6	8
Railroads.....	4	8	12	Law.....	14		14
Manufactures.....	14	22	36	United States Government documents.....		62	62
				Total.....	1,023	2,291	3,314

APPENDIX 9

List of countries from which periodicals are currently received and number of periodicals received from each country

Country	Titles	Country	Titles
Africa:		Iceland.....	1
Algeria.....	8	India (British).....	45
Egypt.....	13	India (Portuguese).....	1
French West Africa.....	1	Ireland:	
Gold Coast.....	1	Irish Free State.....	7
Kenya Colony.....	1	Northern Ireland.....	1
Madagascar.....	2	Italy.....	74
Mauritius.....	1	Jamaica.....	2
Morocco.....	2	Japan.....	30
Nyasaland.....	1	Latvia.....	3
Rhodesia.....	1	Mexico.....	18
South Africa.....	25	Netherlands.....	45
Sudan.....	3	New Caledonia.....	1
Tripoli.....	1	New Guinea.....	1
Tunis.....	7	New Zealand.....	9
Australia.....	51	Norway.....	16
Austria.....	24	Palestine.....	3
Belgium.....	32	Philippine Islands.....	12
Bermuda.....	1	Poland.....	13
Bulgaria.....	2	Porto Rico.....	4
Canada.....	81	Portugal.....	2
Central America:		Rumania.....	11
Guatemala.....	2	Russia.....	37
Panama.....	1	Scotland.....	13
Salvador.....	2	Serb, Croat, and Slovene State.....	1
Ceylon.....	6	Siam.....	1
China.....	10	South America:	
Cuba.....	12	Argentina.....	48
Czechoslovakia.....	30	Brazil.....	30
Denmark.....	33	British Guiana.....	1
Dominican Republic.....	1	Chile.....	11
East Indies:		Colombia.....	4
Java.....	12	Dutch Guiana.....	2
Sumatra and other islands.....	6	Ecuador.....	1
England.....	248	Paraguay.....	3
Estonia.....	2	Peru.....	5
Federated Malay States and Straits Settlements.....	3	Uruguay.....	9
Fiji.....	1	Venezuela.....	6
Finland.....	8	Spain.....	21
France.....	161	Sweden.....	39
French Indo-China.....	3	Switzerland.....	30
Germany.....	243	Tahiti.....	1
Greece.....	3	Trinidad.....	2
Haiti.....	1	Turkey.....	2
Hawaii.....	5	United States.....	1,688
Hungary.....	9	Total.....	3,314

APPENDIX 10

BINDING

	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Number of books sent to bindery.....	3,363	4,064	1,674	2,019	1,866	1,821	2,858	1,417	3,264	3,059
Number of volumes placed in temporary binders.....	1,684	2,000	1,675	1,612	1,000	1,152	1,059	1,762	2,877	2,772
Pamphlets stapled in binders.....	(¹)	1,728	1,443	743	894	622	675	692	726	610
Current numbers added to files already in binders ²									1,409	1,601

¹ Figures not available.² Figures not kept previous to 1924.

APPENDIX 11

Expenditures for library printing and binding for the fiscal years 1919 to 1925

Item	1920	1921	1922	1923	1924	1925
Regular binding.....	\$8,255.30	\$5,537.74	\$12,723.58	\$6,234.28	\$9,534.40	\$11,181.27
Binders.....	606.84	1,151.12	(²)	660.83	518.89	1,421.30
Pamphlet boxes.....					48.70	124.00
Forms.....	259.38	241.64	303.26	318.76	283.79	329.36
Publications.....	84.30	94.61	889.17	73.36	88.86	115.11
Index cards.....			578.27	157.12	137.93	
Miscellaneous.....	4.88	6.09	55.31	16.20	8.69	
Total.....	9,210.70	7,031.20	14,549.59	7,460.55	10,621.26	13,171.04

¹ Includes regular binding and binders. ² Separate figures not available; included with regular binding.

APPENDIX 12

Financial statement, fiscal years 1916 to 1925

RECEIPTS

Source:	Fiscal year—									
	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Library appropriation—										
Statutory salaries.....	\$29,720.00	\$31,520.00	\$32,160.00	\$32,160.00	\$32,160.00	\$32,880.00	\$30,060.00	\$32,660.00	\$32,660.00	\$40,000.00
General expenses.....	16,300.00	18,000.00	18,000.00	18,000.00	18,000.00	22,000.00	21,400.00	25,000.00	30,000.00	30,960.00
Total.....	46,020.00	49,520.00	50,160.00	50,160.00	50,160.00	54,880.00	51,460.00	57,660.00	62,660.00	70,960.00
From department printing and binding fund.....	9,662.12	8,707.52	12,068.38	5,358.21	9,210.70	7,031.20	14,549.59	7,400.64	10,621.26	13,171.04
Main library salaries paid by bureaus.....					1,467.50	5,221.67	7,560.02	10,472.89	12,257.50	15,117.84
Grand total.....	55,682.12	58,227.52	62,228.38	55,518.21	60,838.20	67,132.87	73,569.61	75,533.53	85,538.76	99,248.88

EXPENDITURES

Books and serials.....	\$8,840.89	\$8,975.89	\$7,257.40	\$7,186.86	\$9,246.05	\$9,439.69	\$9,998.58	\$11,182.48	\$11,138.26	\$13,582.31
Periodicals.....	3,978.46	4,093.62	4,252.74	6,139.99	5,231.48	6,039.62	6,353.08	7,008.48	6,916.54	16,957.19
Maps.....		215.00	40.88	70	62.04					
Index cards.....	169.59	129.07	78.86	85.25	112.23	178.51	141.88	172.45	147.37	162.45
Furniture, shelving, and miscellaneous equipment.....					293.16	2,525.94	29.91	2,435.20	1,738.15	2,1,908.83
Traveling expenses.....	31.20	866.85	765.88	604.04	48.52	219.72	190.23	177.52	971.06	
Freight, express, and drayage.....		10.62	16.24	37.75	93.07	56.94	62.90	13.95	21.51	44.97
Supplies and repairs.....	429.16	469.24	981.33	609.01	539.58	518.50	566.76	1,459.67	1,136.98	3,1,015.01
Truck service.....							9.87	52.78	38.89	81.81
Newspapers.....								94.16	99.32	97.80
Salaries (statutory).....	29,634.73	30,960.32	31,523.92	29,401.95	29,106.85	27,013.25	30,059.01	32,219.04	31,960.67	39,799.96
Salaries (miscellaneous).....	1,643.33	2,065.21	1,748.33	2,039.00	2,356.00	2,921.35	3,931.62	2,394.35	7,774.99	6,194.51
Total.....	45,594.21	47,471.23	46,665.58	46,283.99	47,088.98	48,913.52	51,344.44	57,210.08	61,943.74	69,824.84
Printing.....	1,806.79	1,727.17	1,576.78	652.75	348.56	342.34	1,826.01	579.03	567.97	444.47
Binding.....	7,855.33	6,980.35	10,491.60	4,705.46	8,862.14	6,888.86	12,723.58	6,881.61	10,053.29	12,726.57
Main library salaries paid by bureaus.....					1,467.50	5,221.67	7,560.02	10,472.89	12,257.50	15,117.84
Grand total.....	55,236.33	56,178.75	58,733.96	51,642.20	57,767.18	61,166.39	73,454.05	75,143.61	84,822.50	98,113.72
Credit received for duplicates exchanged with book dealers and libraries.....									954.75	604.35
Gifts.....									12.94	10.75

1 Outstanding liabilities for books, periodicals, and serials: \$790.74.

2 Itemized as follows:

Office furniture and equipment.....	\$249.79									\$124.24
Steel shelving.....	358.74									159.95
Floor covering.....	269.10									104.74
Wooden shelving, stools, and ladders.....	1,631.20									38.86
Total.....	1,908.83									42.55
Repairs and alterations—										
Carpeting work.....										513.28
Electrical work.....										
Typewriter and adding machine repairs.....										
Picture framing.....										
Painting and cleaning.....										
Miscellaneous repairs.....										
Total.....										

APPENDIX 13

ORDER WORK AND BOOKKEEPING

The record of the order work and bookkeeping for the past five years is given in the following table:

Year	Requisitions issued				Vouchers audited
	For books and periodicals	For supplies	For shop work	For printing and binding	
1921.....	1,569	67	132	41	956
1922.....	2,060	83	122	77	1,176
1923.....	2,481	126	160	49	1,337
1924.....	2,333	77	233	47	1,234
1925.....	2,592	66	150	46	1,311

A comparison of the receipts and expenditures of the Library for the past 10 years is given in Appendix 12, page 15.

APPENDIX 14

BUREAU LIBRARIES ¹

Bureau or office	Number employed	Number of books	Number of pamphlets	Number of periodicals currently received	Number of registered borrowers	Number of registered borrowers to whom periodicals are circulated
Bureau of Agricultural Economics, Miss Mary G. Lacy, librarian.....	² 14	⁴ 25,000	(³)	⁴ 1,504	310	⁵ 138
Bureau of Animal Industry, Miss Florence M. Thompson, librarian.....	2	-----	-----	500	(³)	68
Animal Husbandry Division, Mrs. H. Callahan, in charge.....	1	3,800	⁴ 2,800	⁴ 260	⁴ 50	-----
Bureau of Chemistry, Miss Louise Duvall, librarian.....	² 4	9,040	(³)	470	261	135
Bureau of Dairying, Miss Carrie B. Sherfy, librarian.....	3	550	4,500	346	61	58
Bureau of Entomology, Miss Mabel Colcord, librarian.....	3	9,300	10,700	847	⁴ 115	22
Forest Service, Miss Helen E. Stockbridge, librarian.....	1	⁶ 24,628	(³)	166	132	70
Bureau of Home Economics, Mrs. Eva Thayer Shively, librarian.....	22	(³)	(³)	142	(³)	24
Bureau of Plant Industry, Miss Jessie M. Allen, librarian.....	² 10	⁴ 200	⁴ 1,100	900	(⁷)	167
Bureau of Public Roads, Miss Orrena L. Evans, librarian.....	3	⁴ 5,000	⁴ 8,300	295	169	101
Office of Experiment Stations, Miss Martha L. Gericke, librarian.....	² 8	⁴ 3,700	51,244	950	(³)	75
Office of the solicitor, Mr. F. D. Scott, in charge.....	1	⁴ 2,000	(³)	(³)	(³)	(³)

¹ Books for use of the department in Washington, including those filed in the bureaus, are purchased and catalogued by the main library. No bureau library is maintained by the Bureau of Biological Survey or by the Bureau of Soils. The Weather Bureau library is administered separately, with the exception that the books and periodicals are purchased from the appropriation for the library of the department, the sum of \$1,000 being set aside each year for this purpose. The report of the Weather Bureau library is contained in the report of the Weather Bureau.

² Including messengers.

³ Figures not available.

⁴ Approximate figures.

⁵ Offices.

⁶ Books and pamphlets.

⁷ Book circulation handled in main library.

REPORT OF THE GRAIN FUTURES ADMINISTRATION

UNITED STATES DEPARTMENT OF AGRICULTURE,
GRAIN FUTURES ADMINISTRATION,
Washington, D. C., October 1, 1925.

SIR: I submit herewith the annual report of the Grain Futures Administration for the year ended June 30, 1925. In the interest of economy there has been included as a part of this report a series of statistical tables relating to transactions in grain futures during the past year, with such comparisons with previous years as are essential to a full understanding of the subject matter involved.

Very respectfully,

J. W. T. DUVEL,
In Charge.

Hon. WILLIAM M. JARDINE,
Secretary of Agriculture.

The activities of the Grain Futures Administration during the past year were along various lines. In addition to analyzing the reports received daily from the clearing members of the various contract markets showing the volume of trading, customers' open commitments, and information pertaining to the transactions of large speculators, special attention was given to the character of the crop and market information furnished customers and the general public as a basis for trading. Likewise, examinations were made of the books and records of a number of concerns not only in Chicago but also in New York, Cincinnati, and other cities. Some attention was also given to the deliveries on future contracts and the experience of operators of country elevators in their "futures" transactions, with special reference to hedging operations.

At Chicago an effort was made to keep an observer on the exchange floor at all times during the session. For a short period complaint was registered by some members of the exchange because the observer entered the pits, but this was found necessary in order to obtain a true picture of the trading operations and the influences at work at all times, and more particularly on days when price fluctuations were unreasonably wide.

To insure a closer supervision of future transactions and to facilitate the handling of the reports, a branch office was opened at Kansas City with a representative of the Grain Futures Administration in charge.

As a result of the unwarranted fluctuations in grain prices and the criticisms made by various interests because of them, a special and detailed investigation was ordered by the Secretary of Agriculture on March 18, with a view to discovering the causes and what means could be adopted for preventing a recurrence. This investigation has not been completed, and the results will be covered in a separate report.

TRADING IN WHEAT, CORN, OATS, AND RYE ON THE VARIOUS "CONTRACT MARKETS"

The volume of trading in grain futures in the United States from July 1, 1924, to June 30, 1925, was the largest for any similar period since the Grain Futures Administration started to collect data on future trading. The total number of bushels of all grains traded in during that period amounted to 31,416,196,000. Although 10 markets are licensed to deal in grain futures, this report gives figures for only 9 of them, as no trading was done at Baltimore, Md.

January, 1925, when the price of May wheat rose to \$2.05½, and March, 1925, when the price declined to nearly \$1.40, were the two months during the past fiscal year when the heaviest trading took place. The volume of trading for each of these two months was the largest for any single month during the past four and a half years. The trading on March 13 was probably the largest for any single day in the history of the Chicago Board of Trade. The volume on that day for all futures in all grains amounted to 256,529,000 bushels.

Table 1 indicates not only that as in prior years the largest volume of trading in grain futures took place at Chicago, but also that the Chicago

more clearly in Figures 1 and 2. Figure 1 shows the monthly volume of trading in all grain futures on the Chicago Board of Trade in comparison with the total monthly trading on all contract markets. Figure 2 shows a similar comparison for the wheat futures only.

WHEAT FUTURES

The volume of trading in all wheat futures increased from 10,082,284,000 bushels in 1923 to 11,222,971,000 bushels in 1924. The quantity dealt in on the Chicago Board of Trade in 1924 was over 1,000,000,000 bushels more than during 1923. The number of bushels for Minneapolis, Kansas

TABLE 1.—*Grain futures: Volume of trading in each of seven grain futures markets of the United States, by calendar years, for the period 1921 to 1924*

[Volume of trading in grain futures, in thousands of bushels, i. e., 000 omitted]

Market	1924		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Chicago Board of Trade.....	20,954,516	88.16	17,492,935	88.14	13,930,551	86.29	17,827,070	87.39
Chicago Open Board of Trade.....	505,958	2.13	463,964	2.34	445,137	2.76	497,601	2.44
Minneapolis Chamber of Commerce.....	1,087,194	4.57	752,384	3.79	754,870	4.67	918,662	4.50
Kansas City Board of Trade.....	703,480	2.96	570,214	2.87	525,649	3.26	605,833	2.97
Duluth Board of Trade	220,344	.93	314,506	1.59	295,224	1.83	355,601	1.74
St. Louis Merchants Exchange.....	250,868	1.06	189,143	.95	137,964	.85	143,708	.71
Milwaukee Chamber of Commerce.....	45,090	.19	63,762	.32	54,272	.34	50,144	.25
Total.....	23,767,450	100.00	19,846,908	100.00	16,143,667	100.00	20,398,619	100.00

Board of Trade is the only organization whose percentage of the total volume of trading increased during 1924 as compared with that for 1923. The increase amounted to 1.1 per cent. All other markets had a slight decrease. In terms of bushels traded in, every market had an increase. At Chicago, Minneapolis, Kansas City, and Duluth the number of bushels traded in during 1924 was the largest since 1921. This is also true for the total volume of trading for the seven most important markets, as the volume for 1924 was over 4,250,000,000 bushels more than for 1923 and 500,000,000 more than for 1922.

The relative importance of Chicago as a grain-futures market is shown

City, and St. Louis also shows an increase over the figures for the previous year, whereas those for Duluth and Milwaukee decreased. The proportion of the total volume of trading in wheat futures in seven markets shows an increase for the Chicago Board of Trade and the Minneapolis Chamber of Commerce. In the latter case the percentage of the total volume was the largest during the four-year period. The other markets, on the other hand, received a smaller share in 1924 than in 1923. In Duluth, trading in durum wheat represented 99.5 per cent of the total trading in wheat futures. The details for the trading in wheat futures on the various markets are shown in Table 2.

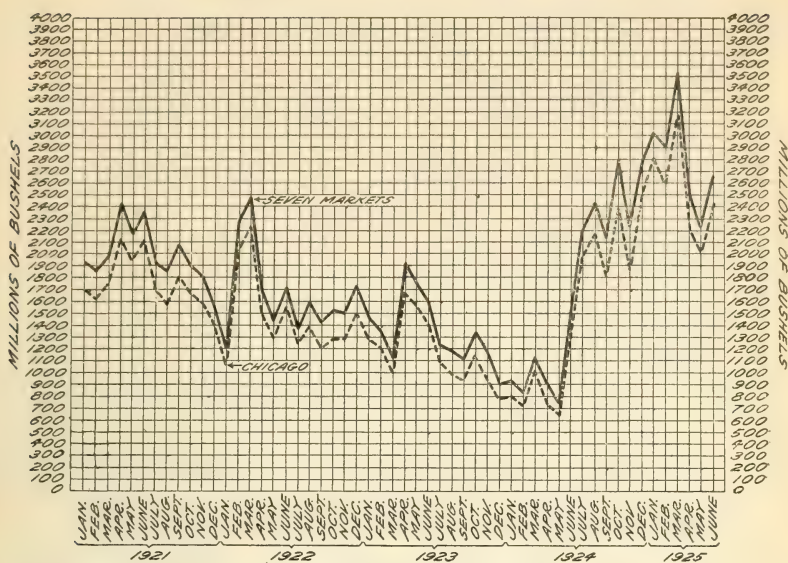


FIG. 1.—Monthly volume of trading in grain futures in all markets and on the Chicago Board of Trade January, 1921, to June, 1925

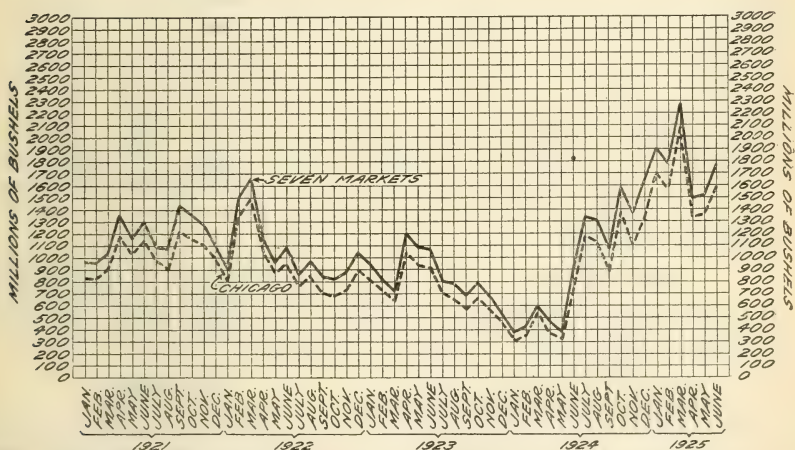


FIG. 2.—Monthly volume of trading in wheat futures in all markets and on the Chicago Board of Trade, January, 1921, to June, 1925

TABLE 2.—*Wheat futures: Volume of trading in each of seven grain futures markets of the United States, by calendar years, for the period 1921 to 1924*

[Volume of trading in grain futures, in thousands of bushels; i. e., 000 omitted]

Market	1921		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Chicago Board of Trade	12, 273, 650	86. 83	11, 072, 545	87. 18	8, 572, 111	85. 08	9, 597, 315	85. 51
Chicago Open Board of Trade	237, 780	1. 68	366, 559	2. 89	328, 452	3. 26	330, 125	2. 94
Minneapolis Chamber of Commerce	788, 446	5. 58	503, 956	3. 97	544, 600	5. 40	642, 607	5. 73
Kansas City Board of Trade	527, 560	3. 73	393, 181	3. 10	347, 169	3. 44	371, 676	3. 31
Duluth Board of Trade	175, 052	1. 24	198, 264	1. 56	184, 400	1. 83	174, 805	1. 56
St. Louis Merchants Exchange	126, 857	. 90	139, 471	1. 10	83, 187	. 83	91, 119	. 81
Milwaukee Chamber of Commerce	10, 213	. 07	25, 791	. 20	22, 365	. 22	15, 324	. 14
Total	14, 139, 558	100. 00	12, 699, 767	100. 00	10, 082, 234	100. 00	11, 222, 971	100. 00

TABLE 3.—*Corn futures: Volume of trading in each of seven grain futures markets of the United States, by calendar years, for the period 1921 to 1924*

[Volume of trading in grain futures, in thousands of bushels; i. e., 000 omitted]

Market	1921		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Chicago Board of Trade	5, 830, 304	91. 78	4, 506, 683	93. 16	4, 286, 837	92. 21	5, 759, 327	92. 66
Chicago Open Board of Trade	212, 181	3. 34	84, 742	1. 75	111, 838	2. 41	152, 028	2. 44
Minneapolis Chamber of Commerce	(¹)	-----	7, 941	. 17	473	. 01	(¹)	-----
Kansas City Board of Trade	168, 538	2. 65	168, 447	3. 48	176, 105	3. 79	232, 430	3. 74
Duluth Board of Trade ¹								
St. Louis Merchants Exchange	122, 301	1. 93	46, 592	. 96	54, 152	1. 16	52, 589	. 85
Milwaukee Chamber of Commerce	19, 060	. 30	23, 201	. 48	19, 650	. 42	19, 326	. 31
Total	6, 352, 384	100. 00	4, 837, 606	100. 00	4, 649, 055	100. 00	6, 215, 700	100. 00

¹ No trading in corn futures.

CORN FUTURES

The total volume of trading in corn futures in the seven markets was exceeded only by that for 1921. The 1924 figures are over one and one-third billion bushels larger than for 1922 and one and one-half billion more than for 1923. Both the volume in terms of bushels and in percentage of the total volume of trading in the seven markets shows an increase for Chicago as compared with the figures for 1922 and 1923. Kansas City had an increase in the number of bushels traded in but a decrease in the percentage of the total volume traded

in. The other markets had a decrease both in the number of bushels traded in and in the percentage of total volume handled on the seven markets, as shown in Table 3.

OATS FUTURES

During 1924 the volume of trading in oats futures was more than double the volume for the previous year and considerably larger than that for 1922. Of the total volume, 91.16 per cent was handled through the Chicago Board of Trade which is the highest percentage for any year during the

1921-1924 period. The proportion of the total volume of business in 1924 handled on the individual markets outside of Chicago declined when compared with 1923. The number of bushels, however, traded in at Minneapolis and Milwaukee increased while

any one of the previous three years. The biggest share of the business, or more than 75 per cent, was done through the Chicago Board of Trade. This is an increase of 14 per cent as compared with 1923 and approximately 3.5 per cent more than in 1922.

TABLE 4.—Oats futures: Volume of trading in each of seven grain futures markets of the United States, by calendar years, for the period 1921 to 1924

[Volume of trading in grain futures, in thousands of bushels; i. e., 000 omitted]

Market	1921		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Chicago Board of Trade.....	2,653,688	89.29	1,559,923	88.10	788,303	87.82	1,766,940	91.16
Chicago Open Board of Trade.....	55,997	1.88	12,659	.72	4,744	.53	14,077	.73
Minneapolis Chamber of Commerce.....	237,679	8.00	173,962	9.83	92,289	10.28	143,670	7.41
Kansas City Board of Trade.....	7,382	.25	8,586	.48	2,375	.27	1,727	.09
Duluth Board of Trade ¹								
St. Louis Merchants Exchange.....	1,710	.06	3,080	.17	625	.07	(¹)	-----
Milwaukee Chamber of Commerce.....	15,353	.52	12,339	.70	9,270	1.03	11,907	.61
Total.....	2,971,809	100.00	1,770,549	100.00	897,606	100.00	1,938,321	100.00

¹ No trading in oats futures.

TABLE 5.—Rye futures: Volume of trading in each of seven grain futures markets of the United States, by calendar years, for the period 1921 to 1924

[Volume of trading in grain futures, in thousands of bushels; i. e., 000 omitted]

Market	1921		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Chicago Board of Trade.....	192,464	84.49	353,230	71.70	283,035	61.02	703,488	75.18
Chicago Open Board of Trade.....	(¹)	-----	4	-----	103	.02	1,371	.15
Minneapolis Chamber of Commerce.....	18,640	8.18	40,484	8.22	93,448	20.15	96,626	10.33
Kansas City Board of Trade.....								
Duluth Board of Trade.....	16,245	7.13	96,495	19.59	84,255	18.17	130,670	13.96
St. Louis Merchants Exchange ¹								
Milwaukee Chamber of Commerce.....	455	.20	2,420	.49	2,987	.64	3,587	.38
Total.....	227,804	100.00	492,633	100.00	463,828	100.00	935,742	100.00

¹ No trading in rye futures.

at Kansas City it decreased. No trading in oats occurred at St. Louis or Duluth. The complete figures are shown in Table 4.

RYE FUTURES •

The volume of trading in rye futures during 1924 was not far from double the largest quantity traded in during

In terms of bushels it is nearly twice the volume done in 1922 which was the best in the three prior years. The proportion of the total volume handled in markets outside of Chicago in 1924 decreased, although the quantity of bushels traded in increased in each market where trading in rye futures is carried on, as shown in Table 5.

TRANSACTIONS IN FLAX FUTURES

Trading in flax futures is carried on only in Duluth and Minneapolis. The total volume of trading in 1924 in these cities exceeded the largest figure for any year during the four years of 1921 to 1924 by approximately 17,000,000 bushels. Almost 79 per cent of the trading took place on the Duluth Board of Trade, whereas 21 per cent of the trading can be accredited to Minneapolis. While the quantity traded in at Minneapolis increased in 1924 over 1,000,000 bushels as compared with 1923, the increase at Duluth was almost 24,000,000 bushels, or nearly double the volume traded in during the previous year.

FUTURE TRADING IN BARLEY

Trading in barley futures during the past year was carried on only in Minneapolis, San Francisco, and Los An-

these eastern State shipments was uncertainty as to European demand, which brought about high prices and subsequently lower prices. These extremes probably were not entirely established through the natural operations of supply and demand, and strongly emphasized the need of more desirable rules and trading regulations.

RANGE OF PRICES OF MAY WHEAT AT LIVERPOOL, WINNIPEG, AND CHICAGO

The "life" of the active May wheat future in the Liverpool market extended from November 13, 1924, to May 21, 1925. At Liverpool during this period there were 9 days, at Chicago 50 days, and at Winnipeg 54 days, when the daily range in price of the May future was 5 cents or more per bushel. The widest daily range in price at Liverpool occurred on March 16 when the difference was 9 cents per bushel, and on March 18 when the range was 12½

TABLE 6.—*Flax futures: Volume of trading in Minneapolis and Duluth futures markets by calendar years, for the period 1921 to 1924*

[Volume of trading in flax futures, in thousands of bushels; i. e., 000 omitted]

Market	1921		1922		1923		1924	
	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total	Volume	Per cent of total
Minneapolis Chamber of Commerce.....	17,619	37.76	9,202	31.79	12,279	31.61	13,414	21.11
Duluth Board of Trade.....	29,047	62.24	19,747	68.21	26,569	68.39	50,126	78.89
Total.....	46,666	100.00	28,949	100.00	38,848	100.00	63,540	100.00

geles. Of the total volume 90 per cent was traded in at Minneapolis, 9.4 per cent at San Francisco, and 0.6 per cent at Los Angeles. The number of bushels traded during the period of July 1, 1924, to June 30, 1925, in all three markets amounted to 38,626,000 bushels, of which 34,766,000 are credited to Minneapolis, 3,619,000 to San Francisco, and 241,000 to Los Angeles.

The importance of barley as the leading grain crop of California, and the large volume of export and the domestic consumption as whole and rolled barley imposes greater importance upon future trading in barley and the designated exchanges at San Francisco and Los Angeles than the volume of trading data would indicate.

The short barley crop in California in 1924 resulted in the heavy importation of eastern barley and created unusual and extreme fluctuations in prices. Combined with the effect of

cents. Evidently the Liverpool prices were markedly increased by the severe break in prices in Chicago and Winnipeg on March 13 and 17.

The average daily range in price for the period in Liverpool was 2.2 cents, while in Chicago it was 4.43 cents, and in Winnipeg 4.65 cents. The explanation advanced as to why the average at Liverpool is one-half of that for Chicago and Winnipeg, is that in Liverpool a larger percentage of the future trading is more closely tied up to their cash-grain transactions, whereas in the two larger North American markets the speculative element plays the more important rôle.

A study of the price-range figures, as shown in Table 13, indicates that the wide fluctuations in Chicago were also manifested in Canada, even to a slightly greater extent. This is to be expected as price changes in one North American market are soon reflected in

the others. A comparison of the daily price ranges of the May wheat futures in 1924-25, as shown in Table 13, with those for 1914, as shown in Table 14, emphasizes the fact that the ranges for the past year were considerably larger than during 1914 when the wheat market was more stable. For 1914, the average daily range was 0.5 cent per bushel at Winnipeg and 0.68 cent at Chicago. In other words, the average daily price range for May wheat in Winnipeg for 1924-25 was approximately nine, and in Chicago about six and a half times as large as it was in 1914. The reasons given by members of the grain trade in explanation of the tremendous fluctuations during the past year are discussed briefly in another section of this report.

FLUCTUATIONS IN THE PRICE OF MAY WHEAT

The crop year of 1924-25 was an unusual one from a number of standpoints. (1) The volume of trading in grain futures was the largest according to the records of the Grain Futures Administration.¹ (2) It followed a rather dull year on the grain exchanges when the volume of trading in futures was relatively small compared with previous years. (3) The season was one in which there was a marked shortage in the world's supply of wheat. (4) It was a season of wide fluctuations. The range in the price of the May wheat future was the greatest since 1921. The range between the low and the high price during the life of the 1922 May wheat was 46 $\frac{5}{8}$ cents; the 1923 May wheat, 22 $\frac{1}{4}$ cents; the 1924 May wheat, 14 $\frac{3}{8}$ cents; and for the 1925 May wheat, 86 $\frac{1}{4}$ cents.

During the life of the 1925 May wheat future many sharp price changes were witnessed. On numerous days the price range was 5 cents, on others as high as 10 cents or more, and on two occasions over 13 cents.

The period covering the life of the May wheat future can be divided into three main divisions: The first covering the interval from June 30, 1924, to January 28, 1925; the second from January 29 to April 3, and the third from April 4 to May 29, when the future expired.

In the first division the price of May wheat advanced from \$1.19 $\frac{5}{8}$ to \$2.05 $\frac{7}{8}$, or 86 $\frac{1}{4}$ cents. On the whole,

the rise was fairly uniform. The daily range was, with but five exceptions, less than 5 cents per bushel.

The underlying causes contributing to this advance to \$2.05 $\frac{7}{8}$ were: (1) The belief that a world scarcity in bread grains would develop. (2) A shortage in the corn crop of the United States. Associated with these causes were the newspaper articles and other publicity issued regarding the presumed scarcity and the big profits made by various speculators, which stimulated buying of wheat futures on the part of the public, and consequently resulted in increasing the price.

During the period of advancing prices complaints were received from various sources contending that speculation had driven up unduly the price of wheat in the United States. Consequently, the former Secretary of Agriculture made public a statement on January 6 to the effect that the price of May wheat, which at that time was \$1.78, was not unreasonable on the basis of world conditions as known at the time. Unfortunately, when the price of May wheat rose to \$2 and above the latter part of January the public erroneously implied that the statement released by the former Secretary applied to the higher prices.

From the high of \$2.05 $\frac{7}{8}$ on January 28 to April 3 the price of May wheat dropped 69 $\frac{3}{8}$ cents. In the early part of this period the price declined from the high point \$1.77 $\frac{1}{2}$, then a reaction carried it back to \$2.02. From that figure it fell to \$1.51, from which point it advanced to \$1.62 $\frac{1}{4}$, only later to drop to \$1.36 $\frac{1}{2}$.

In those 9 weeks there were 25 days on which the daily range in price was 5 cents or more, whereas in the 29 weeks prior to January 28 there were only 5 days on which the range was that large.

On February 9, 1925, a statement was released by the supervisor of the grain exchanges, calling attention to the inability to justify the wide daily price fluctuations with the law of supply and demand for real wheat, and that it would become necessary to find some means of preventing them. Also, that such remedial measures as might be necessary should come from within the grain exchanges rather than from without. In the face of the warning, wide fluctuations continued and even increased to the extent of 13 $\frac{1}{4}$ cents on March 13 and 13 $\frac{1}{2}$ cents on March 30. The violent fluctuations created severe

¹ The compiling of data started in January, 1921.

criticism not only in America² but also in Europe, and resulted in the instigation of a special investigation by the United States Department of Agriculture with a view of ascertaining the reasons for the price changes, whether or not manipulation in prices had taken and what steps ought to be taken to prevent a repetition.

CUSTOMERS' OPEN INTEREST IN GRAIN

Figures for the past fiscal year indicate that from the 1st of June on, the general tendency is for the aggregate "open interest" for customers in all grain futures to increase until the peak is reached in November or December, and from then on they decrease. Each grain and each future has a "peak" of its own, which may or may not be the same as for other grains.

Figure 3 shows the rapid increase in the customers' aggregate "open interest" in all wheat futures on all markets at monthly intervals, the total open interest in the May wheat future for all markets, for Chicago, and the total for markets other than Chicago.³

A comparison of the curve for May wheat at Chicago, as shown by *C*, Figure 3, with curve *E* representing all markets outside of Chicago, reveals the far greater variation in the Chicago open interests with that of other markets. The reason for this lies in the fact that at Duluth, Kansas City, St. Louis, and Milwaukee, the customers' open interest primarily grows out of hedging operations, whereas at Chicago there is a much higher percentage of speculative commitments. This is clearly illustrated by figures presented in Senate Document No. 110, in which open interests of 45 hedging accounts are given by weekly intervals gradually rising from June to December and gradually falling off from January to June.

² At their convention on April 16 and 17, the Millers' National Federation adopted the following resolution:

Resolved, That trading in futures is a necessary factor in the economic marketing of grain. Such trading should be confined to its legitimate purpose. Inordinate speculation, of which the widely fluctuating markets of the past several months have given renewed evidence, is an intolerable evil, destructive of legitimate business, and should be abolished. We urge upon the exchanges themselves the prompt elimination of this vast, indiscriminate speculation, and the formulation of such regulations as may restore trading in futures to its original and only justified purpose: Be it also

Resolved, That a committee of five be appointed by the chairman of the board to consider methods, to confer with officials or committees of the grain exchanges regarding the removal of the existing recognized abuses, and to take such further action as they may find expedient.

³ See Tables 23 and 25 for 1924-25 figures.

The most rapid monthly increase in open interests in the May wheat futures at Chicago occurred during November, when the increase was 47,000,000 bushels. The sharpest decline took place during April, when the open interest decreased 34,000,000 bushels.

The highest total monthly open interest in corn for all markets during the past fiscal year occurred in February and the lowest in June, 1925; for oats, the highest was in January, 1925, and the lowest in July, 1924; for rye, the highest was in October, 1924, and the lowest in June, 1925.

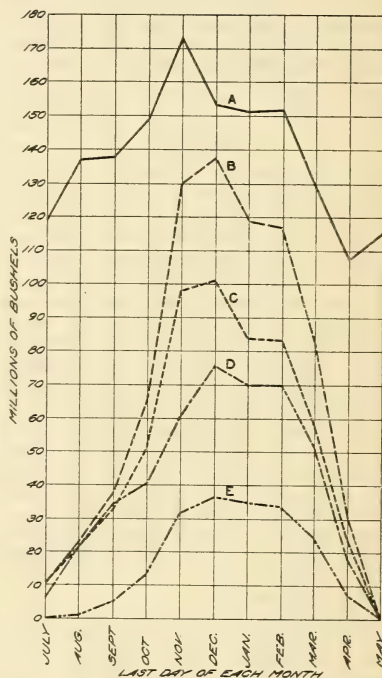


Fig. 3.—Chart showing the customers' aggregate "open interest" by monthly intervals during the period of July 31, 1924-May 31, 1925, for six markets in all wheat futures and in May wheat for five and six markets; also the customers' "open interest" for the 1924 and 1925 May wheat futures at Chicago

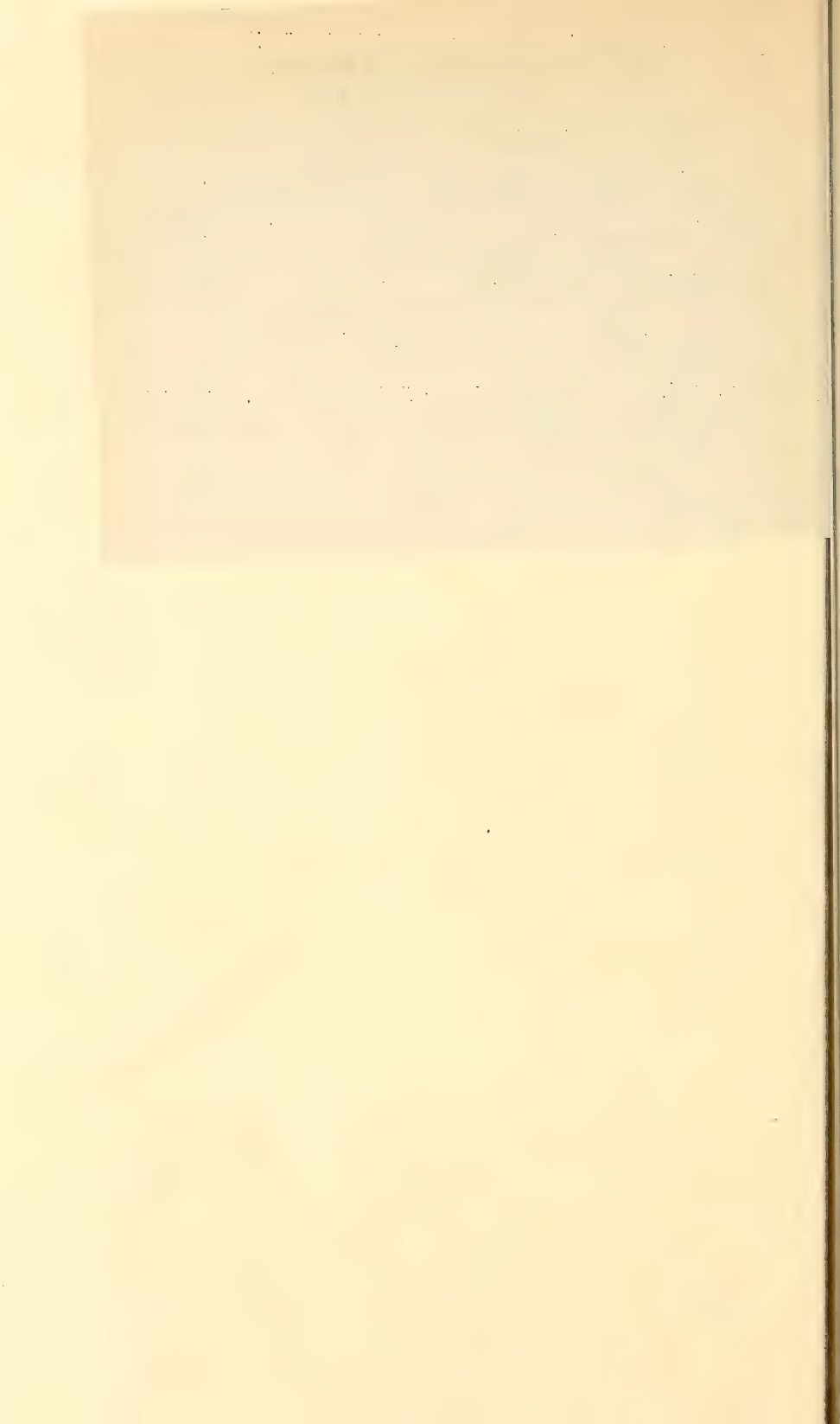
SPECIAL ACCOUNTS

Whenever a customer on the books of any clearing member of the Chicago Board of Trade is long or short to the extent of 500,000 bushels of wheat, corn, or oats, or 200,000 bushels of rye, a report must then be made daily to the Grain Futures Administration regarding the operations of these individuals as long as their position continues to be equal to or over the totals

ADDENDUM TO REPORT OF THE GRAIN
FUTURES ADMINISTRATION, 1925.

Key to Figure 3, on page 8.

- A- All markets - all wheat futures 1924-1925.
- B- All markets - May wheat future 1924-1925.
- C- Chicago May wheat future 1924-1925.
- D- Chicago May wheat future 1923-1924.
- E- All markets outside of Chicago - May wheat future 1924-1925.



mentioned. These special accounts are records of the trading operations of large speculators, hedgers, and a number of commission houses.

During the past fiscal year the open interest represented by these special accounts were of unusual importance, because much of the criticism made with respect to the wide fluctuations in wheat was aimed at those who were long or short a large quantity of wheat futures. That the operations of the large speculators were an important factor in the market can not be denied, as their total open interest represented no small part of that for all customers combined.

Tables 8, 9, 10, and 11 give a comparison between the open interest of special accounts and that of all customers of clearing members of the Chicago Board of Trade at the end of each month during the period of July 31, 1924, to June 30, 1925. The figures for the total customers' open interest are the same for the long side as for the short side and, therefore, only one set of figures is given. The open interest on the long and the short side for the special accounts are not the same, however, and this accounts for both the long and short position being shown.

For the past fiscal year the open interest of the special accounts on the long side represented about 22 per cent of the total customers' open interest in wheat, approximately 10 per cent in corn, 17 per cent in oats, and 32 per cent in rye. On the short side their interest was nearly 30 per cent in wheat, 17 per cent in corn, 42 per cent in oats, and 45 per cent in rye. When the open interest of a special account falls below 500,000 bushels in wheat, corn, or oats, and 200,000 bushels in rye, the position of the individual account is not reported. Therefore, the foregoing percentages are somewhat lower than the actual open interest figures in the columns for the special accounts indicate. However, they give a fairly good picture of what the actual position of these accounts were.

From a further study of the tables it can be seen that:

1. The speculative interest of the public, i. e., the total open interest minus that of the special accounts, was principally centered in wheat and corn, although the total customers' open interest for the year was the highest in wheat followed by oats, corn, and rye.

2. The short interest of the special accounts as compared with that of all customers was the largest in rye, second in oats, third in wheat, and the smallest

in corn. On the long side rye was the largest followed by wheat, oats, and corn. The higher percentage of open interest on the short side in oats and rye for the special accounts was due to heavy hedging operations of some "houses."

3. The total open interest of the special accounts on both the long and short side was the greatest during November and December except in the case of the short side of corn which was highest in April.

4. The number of special accounts on either side during any one month were more numerous in wheat, it having a maximum of 44, followed by oats with 29, rye with 18, and corn with 14.

5. The long interest in wheat for the special accounts at the end of March had declined from approximately 27 per cent to 12 per cent, indicating that heavy liquidation had occurred during March. In April the short side of the special accounts declined about 14 per cent, showing that heavy short covering and the switching of hedges took place during the 30 days prior to the May delivery month.

6. From July to and including December the open interest for the special accounts was larger on the short side than on the long, whereas from January to the last of May the reverse was true with one exception, viz., the month of March, when heavy liquidation took place. In corn, practically the opposite was the case. From July to and including November the long side was the largest, with the exception of one month. From December on, the short side was the largest. The short side of oats and rye was, with the exception of August for oats, the largest throughout the year. The explanation for this is that the hedging transactions of some commission houses were very heavy and made up a good part of the trading in these two grains. This was also true, in no small part, of wheat and corn.

DELIVERIES OF GRAIN ON FUTURE CONTRACTS ON THE CHICAGO BOARD OF TRADE

Very little information is on record concerning the practice followed in making delivery of grain on future contracts on the Chicago Board of Trade, other than the Illinois State law relating to public warehouses and the rules and by-laws of the Board of Trade. The volume of grain delivered, the number of trades settled by the passing of delivery notices, the volume of grain represented by warehouse re-

ceipts, and the number of times receipts are transferred are matters pertaining to the delivery of contract grain of which very little has been published. During the past year, however, information was acquired regarding the making of deliveries.

The method used by the Chicago Board of Trade for delivering grain on futures contracts is entirely different from that practiced at other contract markets. The Board of Trade clearing house furnishes a medium which settles only money differences on "closed trades." This procedure produces a more or less complex situation among concerns relative to closing their remaining open contracts. Trades in the street that can not be closed by "direct" or "ring" settlement remain open until closed by "passing notice" or by taking delivery sometime during the delivery month. Where regular

clearing methods are used the entanglement of the street position is entirely eliminated as the clearing association assumes the position of buyer to seller and seller to buyer, hence all trades are closed daily between concerns in the street. Likewise, when deliveries are made, the seller delivers to the clearing house, which in turn allots them to the oldest long account.

As deliveries are now made on the Chicago Board of Trade, part of the "street position" is closed by the "passing" of a delivery notice or accepting delivery. Ordinarily, it is the practice of most concerns to pass the delivery notice, thus closing a "street position."

Figures 4 and 5 show more clearly than can be described the character of these delivery notices and how they are handled. When the first party to whom the notice is presented accept

This Notice is deliverable on Contracts in the Exchange Hall in accordance with the Rules of the Board of Trade of the City of Chicago.

No. 146

DELIVERY NOTICE

JAMES KIDSTON & CO.

635 Postal Telegraph Bldg.

MAY 6 - 1925

Chicago,

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We have on hand ready for delivery the following described Warehouse Receipts, and hereby make tender to you of the same, in fulfillment of our contract of sale to you of

5000 BUS. CONTRACT WHEAT

DATE	WAREHOUSE	Receipt Number	GRADE	QUANTITY		STORAGE	
				BUSH.	LIBS.	RATE	AMOUNT
MAY 5 - 1925	SOUTH CHICAGO ELEVATOR, C-ANNEX	368	1 No 20,000	5102	03	2.00	10.20
				107	03		
				5000			
			DELIVERY PRICE	161			
				8050	00		

JAMES KIDSTON & CO.

E. & O. E.

Baldwin Printing & Stationery Co., Chicago

Per

FIG. 4.—Copy of delivery notice for 5,000 bushels of wheat

delivery, that is, takes the grain and pays for it, the information on the face of the notice, as shown in Figure 4, completes its circulation. However, the first party to whom delivery is made may not accept the grain but may elect to pass the notice and thereby close his own open trade. This process may be repeated several times before the end of the delivery period for the day, the party receiving the notice last being obliged to accept delivery and pay for the grain. These additional indorsements are recorded on the back of the delivery notice, as shown in Figure 5.

The particular notice calling for 5,000 bushels was passed by 17 concerns, thus closing contracts for 85,000 bushels of May wheat. The last party signing on the notice accepted delivery and hence an additional 5,000-bushel trade in May wheat was closed. The circulation of this delivery notice on May 6, therefore closed contracts for 90,000 bushels.

General market conditions have a direct bearing on the number of times a delivery notice is passed. Likewise, the grade and location, together with the condition, quality, and quantity of grain in store, are determining factors.

One of the chief objections to this method of delivery on futures contracts is the uncertainty as to when the grain will be delivered, as those having grain to deliver possess the right to elect when and to whom delivery shall be made. Because of this, some houses may be required to wait for delivery until the last day of the delivery month, irrespective of when their trades were executed.

The volume of trades closed by "passing notices" each year is largely influenced by the volume of trades open and also whether or not concerns are interested in stopping delivery notices. The ratio of the total number of bushels of actual grain delivered to the volume in bushels of futures contracts

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No.	DELIVERED	Time
To		
Lewitz	161 ³ / ₄	8:35
Stark	@ 160 ³ / ₄	8:40
Ames	@ 162	8:45
Barrett	@ 154	8:47
Togian	@ 167	8:50
Jackson	@ 161 ¹ / ₂	8:52
Johnson	@ 161 ¹ / ₂	8:57
Rogers H.	@ 148 ¹ / ₂	8:59
Whitcomb	@ 163 ¹ / ₂	9:00
Johnson	@ 148	9:02
Boullehurst	@ 160 ³ / ₄	9:03
Thal Gann	@ 162	9:07
East T.	@ 144 ¹ / ₂	9:09
Ames	@ 149	9:10
Wache	@ 151	9:14
Steen A	@ 162	9:14
Rogers B	@ 161	9:14
	@	
	@	
	@	
	@	

FIG. 5.—The reverse side of a delivery notice showing to whom the notice was "passed" the time, and the "contract price" at which the grain future was purchased

settled by delivery, denotes the number of times a warehouse receipt is transferred during the delivery month. For December the ratio was very low, due to certain concerns shipping grain out of Chicago, which caused open contracts to be settled in the pit as the quantity of grain available for delivery had been materially reduced. These factors are set forth more clearly in Table 12.

It is apparent after careful study that a modern clearing system is essential for the economic application of deliveries of grain on futures contracts. Its adoption will expedite delivery, eliminate questionable practices, and render valuable financial security to all parties concerned.⁴

Another phase of the delivery procedure that needs improvement is that pertaining to the integrity of warehouse receipts.

Deliveries of grain on futures contracts are effected by the passing of warehouse receipts. In fact, the whole structure of future trading as now conducted rests primarily upon these warehouse receipts. It would appear, therefore, that these receipts should carry the highest degree of integrity and should guarantee delivery of grain of as high a grade as that called for. This is not always the case under the present practice, and thereby is accounted for in part at least the prejudice which exists on the part of mills and others toward accepting deliveries on futures contracts.

In this connection mention may be made of a situation which not only tends further to lessen public confidence in warehouse receipts, but is in essence an affront to the United States Government in that those taking delivery of grain on a futures contract are not always accorded the full privilege extended by the grain standards act.

In the standard form of application and agreement submitted by elevators to the Chicago Board of Trade for designation as regular public elevators there is a clause reading as follows:

It is further understood that owing to inspection on all grain moving in and out of our regular warehouse, we are not to be held responsible in any way for any discrepancy between Illinois State Grain Inspection and the U. S. Government Inspection on grain shipped from our regular warehouse.

This appears to furnish the basis for holding the grade designation of local State inspectors to be final, and denying the right of appeal as provided for in the grain standards act.

⁴ Since the preparation of this report the Chicago Board of Trade, by a large affirmative vote, had provided plans for a modern clearing system.

MARKET INFORMATION

In the marketing of any commodity, information on the factors influencing its supply and demand is sought for. This is especially true where speculation plays an important part. Realizing that such is the case, members engaged in executing trades on the exchanges for their customers put forth a great deal of effort in acquiring abundant and up-to-date information of all kinds for the consideration of their patrons, so that they may formulate opinions as to the future trend of prices and then buy or sell as they deem best for their individual interest. Large sums of money are spent each year in bringing together the material so that the latest news and statistics can be made available.

FLASHES

A study of the information furnished customers and traders has been under way during the past year. This has as yet not been completed. However, some interesting discoveries have so far been made. They are these: (1) Many of the "flashed" (i. e., reports on trading operations in the various pits) were considered to closely border those which one would classify as misleading; (2) crop condition reports were at times vague, conflicting, and could be very much improved upon; and (3) some of the statistics furnished customers were thought by members of the trade to be somewhat unreliable.

The following are types of undesirable "flashes":

1. Stein Alstrin, Norris, Lamson, and Cross Roy sold one-half million July.
2. Bache brokers sold 500 July corn and gave up Udpick.
3. Lewis bought 300 or 400 May oats at 42 and there is a lot for sale there. Lewis is also a heavy seller of July oats.
4. The Grain Marketing Co. have "resting orders" to buy May wheat on scale down.
5. Grain Marketing Co. sold 300 July corn the last few minutes.
6. At 147½ Jackson turned a big seller, followed up by Norris and Sincere.
7. Wrenn just bought 200 May wheat at 155½.
8. J. Barrett sold 200 May wheat at 154.
9. Bartlett-Frazier has bought July oats and sold May at 1½ to 2 cents difference, probably about one-half million.
10. H. Blum selling the wheat.
11. Wheat prices sold off sharply on aggressive selling by brokers who actually act for a leading operator, who is very bearish.
12. Talk on floor is that Livermore is buying wheat.
13. Thomson McKinnon bought half million May wheat.
14. I think the Bartlett-Frazier house is buying corn and buying heavily for the last two days.
15. Logan bought million May-July wheat.
16. Stein Alstrin selling wheat.

The reasons for considering flashes of the above type as closely bordering on the misleading are these: First, they

have not always stated the whole truth because the persons making the statements did not possess all the facts. Instances have been found where the quantity stated in the flash was at variance with the actual amount traded in; second, they almost always tell only one side of the story. For instance, a flash may report when an individual or a "house" is buying heavily in the market, and yet not a word be said when the reverse is the case. Third, they aim to reveal to the public what large speculators are doing in the market so that they may follow or take an opposite stand in the market. In this the "houses" who endeavor to reveal the operations are unfair in that the person or persons referred to are not furnished copies of the information given the public regarding their trading so that they may be able to deny statements that are incorrect.

The Grain Futures Administration called the attention of the officers of the Chicago Board of Trade to the fact that flashes of the type indicated were undesirable and suggested that means be taken to stop the issuance of them. As a result, on June 2, 1925, a new regulation was adopted by the board of directors of that organization which prohibits the naming of any person or persons, quantity, or price in any statements given to the public. The regulation reads:

JUNE 6, 1925.

Under the authority of Section 2 of Rule XXIII-A, every member is prohibited, when disseminating market information, from using the names of individuals, firms or corporations, and from stating definite quantities as having been either bought or sold. Information, however, as to deliveries, when based on substantiated facts, may be disseminated and does not come within the meaning of this regulation.

REPORTS REGARDING THE CONDITION OF CROPS IN THE UNITED STATES

Statements pertaining to crop conditions are often very difficult to verify, because they frequently refer to a very limited area from which no other report has been received, thus making comparisons impossible. Reports coming from the same parts of the country vary because all of those who make statements do not possess the same technical knowledge, nor have they the same experience in judging crop conditions or in recognizing crop diseases. Nevertheless, steps are now being taken to bring about an improvement, as many reports could be made more explicit and possess a greater degree of accuracy.

An examination of some of the gossip pertaining to rust was recently made, and it revealed (a) that the statements made were not always strictly accurate,

(b) that evidently the red leaf rust was being mistaken for black stem rust, (c) that the reports were sometimes conflicting as some seemed to deny the statements made by others, (d) that the early rust reports were often expressions of fear rather than descriptions of damage done, and (e) that the statements made did not give as many details as they ought, as many were vague, confusing, and left much to the reader's imagination. For example, a report contained this sentence: "Found black rust in every field to some extent." Such a statement is almost worthless, because the reader does not know how many fields were visited nor the territory covered. Another illustration is the following message sent in by a crop expert from Detroit, Minn. It reads: "Found black rust in every wheat field entered between Grand Forks (N. Dak.) and here. Infection mostly light at this time, but weather conditions favorable for heavy infection within a week's time." If one looks at a map it will be noted that the shortest distance between Grand Forks and Detroit is probably not less than 95 miles. The question arises as to just how many fields were entered while making this 95-mile trip.

From a study of the gossip pertaining to crop conditions it seems that certain improvements could be made with respect to the reports sent in by crop experts, so that they would be of greater service to the customers. A standard form of report stating clearly the territory visited, giving information as to the route traveled, indicating the number of examinations made over representative areas, with a true statement as to the character of the disease and the extent of damage, if any, would eliminate many misunderstandings.

The obtaining of crop information is highly desirable if trading is to be done intelligently on the exchanges. Such information, however, that is given to the public should be reliable and in sufficient detail so that it will not be misleading. With this in view plans are being made to bring about closer cooperation between the various public and private agencies so as to facilitate the checking of crop and market information that is sent to the members of the grain trade from various sources and which in turn is given by them to the public.

FOREIGN MARKET INFORMATION

During the past year the grain trade has also expressed dissatisfaction with the market and statistical information received from foreign countries. For

example, on March 3, 1925, the ticker tape contained an item which read:

Northwestern India crop officially estimated at 8,440,000 bushels against 10,180,000 bushels in 1924. India shippers buying back new crop futures.

This bit of news was mentioned as one of the factors contributing to the increase in prices of wheat futures at Chicago on that date. The next day the following information was placed on the ticker tape:

Message from New York says: "Yesterday it was claimed India would have no export wheat surplus. To-day India is offering new crop wheat, May-June shipment, at 66 shillings 9 pence, which is far below prices from other export countries."

Referring to these reports one of the grain houses stated in their March 4 market letter:

There have been some extravagant statements in the last day or two that have little basis in fact. An instance of this: It will be remembered that yesterday gossip had it that Indian exports would be stopped, owing to unfavorable crop conditions; yet to-day it developed that India is offering new crop wheat for May-June shipment at prices considerably lower than those quoted by competing countries.

The following is another sample of foreign news which was made public on April 9 and said to be inaccurate:

Export rye.—Yesterday the local representative of a prominent German grain house had a cable stating that the German Government was offering rye for sale. None of the exporters doing business with Germany had such advices. As a result cables were sent to check up the accuracy of the information. A cable was received from Rohstoff, Hamburg, one of the largest importers in Germany, saying "Getreide Commission Dusseldorf report seems untrue. Have not heard anything."

A later cable stated that the Getreide commission was buying spot rye in Hamburg at 140 guilders after early sales had been made there from 135 to 138 guilders; the fact that spot rye at Hamburg had gone to a premium over rye afloat or for shipment was taken as indicating the healthy spot situation in Germany.

That members of the American grain trade are not pleased with the present source of information is further revealed in an April 14 statement of a news agency which reported that there was some talk in the West of making an official issue out of the quantity of wheat afloat as reported by some foreign agencies, and that both in the West and at New York some of the best people in the trade are inclined to question the totals given. This is illustrated in the following items:

On April 15 a report was sent out by an agency to the effect that—

"Following many requests regarding wheat on passage figures a New York agency cabled the London Grain, Seed, and Oil Reporter asking for the latest estimate on the quantity of wheat afloat including the amount going to Russia, and received the following cable this morning:

"Afloat 9,260,000 quarters, including 950,000 quarters to Russia."

"9,260,000 quarters would be equal to 74,080,000 bushels, compared with the [X agency's] figures on passage of 85,392,000 bushels, or 11,312,000 bushels

less than [X's] estimate. The 950,000 quarters on passage to Russia is equal to 7,600,000 bushels."

In a bulletin issued on May 28, 1925, by a prominent house in Chicago the suggestion is made that the United States Government have an American representative abroad to cable the facts relating to foreign market conditions. The bulletin states:

Our attention is called to the fact that (A) is reported as having cabled an estimate abroad of 110,000,000 wheat for Kansas, also emphasizing every possible bearish item and forgetting the bullish ones like yesterday's decrease of almost 13,000,000 bushels in the Bradstreet visible in a single week. It would look as though he were working overtime for the European miller by trying to hold down the price. It begins to look as though we ought to have some American representative to cable the facts abroad.

A bulletin issued later in the day indicated that the statement as to the size of the Kansas crop did affect the Liverpool market:

Liverpool cables market unsettled on (A's) estimate of 110,000,000 bushels for Kansas. London cables market continues idle but no signs of selling pressure; convinced we will be forced to follow you ultimately.

The source of the agency's information was given in a bulletin issued by another company, which said:

It is determined that the special report on Kansas referred to by (A) was sent him by [a southwestern trade paper]. It is not considered authoritative, but of course suits the desire of the foreign buyer. We have learned in the last few years to regard (A) as something of a propagandist for the foreign interests who always desire to get supplies at low prices.

The foregoing quotations are sufficient to show that there evidently is a need for improving the channels through which information pertaining to foreign and American markets and crop conditions is disseminated. The criticisms made are entirely those of the members of the trade and not those of the Grain Futures Administration.

HEDGING BY COUNTRY ELEVATORS

A principal purpose of the futures market is to furnish convenient and economical means of shifting price risks and to provide maximum protection to those engaged in the cash grain business. With this in mind the Grain Futures Administration has carried on, during the past year, concurrently with other work, investigational studies intended to determine how well and under what conditions this purpose is best served by the futures market. By such a study it is hoped to lay a broad foundation for more intelligent use of futures for hedging purposes, and also to bring out inherent defects in the system and possibly discover remedies. In this study the secretaries of several of the State grain dealers' associations,

both farmers and independent, have lent cooperation and assistance.

Thus far the study has been conducted with special regard to the requirements of country grain dealers, because it is in this field that the need for proper information seems most urgent. Considering how intimately the futures market is related to the cash grain business, and that practically all dealers watch closely the futures market and depend upon it more or less as a price guide, there is lacking to a marked degree information and understanding concerning its proper purpose and use.

The Grain Futures Administration has no thought of encouraging greater use of the futures market by country grain dealers; yet if such use should come about naturally as the result of better understanding and to the economic advantage of country dealers, this class of trading, it is believed, would inject a healthy element into the futures market.

As a first step in the study there was mailed some 6,000 questionnaires to country elevators in five States, namely, Iowa, Illinois, Kansas, North Dakota, and Ohio.

The returned questionnaires are expected to show among other things the different purposes for which hedging protection is used by country elevators and the degree of success met with. Different operating policies will be brought out as well as the trend toward greater or less use of futures, together with the factors contributing to the increased or decreased use, as the case may be.

Among other things the questionnaires call for an expression of opinion and suggestions generally on the subject of hedging. A large number of interesting comments and suggestions for improvement of the futures market and the operation of boards of trade generally are found in this part of the replies. There is disclosed a keener interest in these matters than is generally accredited to country operators.

Following the general mail survey a more intensive field study is being made. This is directed very largely to the purpose of collecting actual cases and concrete examples of hedging experience. These are expected to add interest and to strengthen materially treatment that otherwise might be regarded as more or less theoretical and abstract.

The relative advantage of hedging, selling to arrive, moving grain to market on open consignment, or a combination of all is a much debated question among country dealers. Figures are being collected which will throw

considerable light upon this question and better enable dealers to draw proper conclusions.

It is not expected that the study of hedging will enable the Grain Futures Administration to make any definite recommendations or to lay down any specific rules for hedging. Effort will be directed mainly to describing methods and conditions and bringing to public attention in their proper perspective those facts and factors that must be considered in all hedging practice.

An outstanding weakness, and one probably responsible for many business failures among country elevators, is that many of them do not keep records from which can be determined at all times their market position "long" or "short." Many have very complete and comprehensive records in so far as their financial condition is concerned, but which are lacking for purposes of enabling detailed business analysis. This is particularly true of hedging transactions.

In a large number of cases country-elevator companies are required to estimate or arrive at by uncertain mental processes just what their market position is. They are thus led into inadvertent speculation and loss not discovered until too late.

A considerable number of sample forms for the keeping of hedging records have been received from elevators in various sections. These are being studied with the view of incorporating such of them as appear to have special merit in suggested forms that may be published in connection with other study results.

During the past year members of the Grain Futures Administration have addressed a number of meetings of country-elevator managers and operators, State conventions of grain dealers, and others, and have taken part in short-course work where the subject of hedging and related questions have been discussed. In every case the policy has been to try to clear up misunderstanding and misinformation concerning hedging, rather than to urge its use or nonuse.

The country has been unfortunate in receiving most of its education in hedging in the past from those who had something to gain in the way of increased business and commissions. Cases have come to light time after time where operators, acting on this kind of advice, have been led from speculating in cash grain into speculating in futures, sometimes both, all under the mistaken notion that they were hedging. In no small measure has this contributed to the prejudice that exists against hedging in the minds

of country bankers, directors of farmers' elevator companies, and others. This is not so marked in North Dakota, for example, as in Iowa and Illinois, but in the latter two States a very considerable number of the farmers' elevators reporting to us give as their reason for not hedging the fact that the practice is prohibited either by by-law provisions or by order of the board of directors.

The Grain Futures Administration is taking the position that regardless of improper use that may be made of futures, and regardless of the temptations to speculate that sometimes grow out of hedging transactions, no question of real economic importance can suffer by too much information

concerning it; that those most likely to misuse futures will not be saved by shutting off proper information concerning the subject, but, on the contrary, may be helped thereby.

Although the study of hedging operations is in no sense a major project of the Grain Futures Administration, and is carried on only because convenient in connection with administrative work and as part of the investigational duties devolving upon it under the law, the Department of Agriculture, as a whole, nevertheless, has a very special interest in promoting better understanding and more perfect use of all marketing facilities. In furtherance of this purpose the hedging studies are being carried on.

TABLE 7.—*The daily range in the price of the May wheat future compared with the volume of trading on the Chicago Board of Trade, together with the high and low when the range was 5 cents or more*

Year and date	High	Low	Range in cents	Volume of trading (000 omitted)	Year and date	High	Low	Range in cents	Volume of trading (000 omitted)
1924					1925				
July 16.....	134 $\frac{1}{4}$	128 $\frac{3}{8}$	5 $\frac{5}{8}$	1,657	Mar. 27.....	166	157 $\frac{1}{4}$	8 $\frac{3}{4}$	56,360
July 23.....	138 $\frac{1}{4}$	130 $\frac{1}{4}$	8	3,195	Mar. 30.....	158 $\frac{1}{4}$	144 $\frac{3}{4}$	13 $\frac{1}{2}$	63,937
Oct. 15.....	156	150 $\frac{3}{4}$	5 $\frac{1}{4}$	17,581	Mar. 31.....	148	140 $\frac{1}{2}$	7 $\frac{1}{2}$	51,627
Dec. 26.....	181 $\frac{1}{4}$	175 $\frac{3}{8}$	5 $\frac{5}{8}$	57,760	Apr. 2.....	147	142	5	37,386
1925					Apr. 3.....	145	136 $\frac{1}{2}$	8 $\frac{1}{2}$	40,591
Jan. 28.....	205 $\frac{5}{8}$	199 $\frac{1}{2}$	6 $\frac{3}{8}$	89,870	Apr. 4.....	143 $\frac{3}{4}$	137 $\frac{3}{4}$	6	25,691
Feb. 5.....	197	191 $\frac{3}{8}$	5 $\frac{5}{8}$	70,668	Apr. 9.....	153 $\frac{1}{4}$	148 $\frac{1}{4}$	5	26,340
Feb. 6.....	194 $\frac{3}{4}$	185	9 $\frac{3}{4}$	96,262	Apr. 13.....	162 $\frac{1}{4}$	156 $\frac{1}{2}$	5 $\frac{3}{4}$	32,911
Feb. 11.....	187 $\frac{3}{4}$	177 $\frac{1}{2}$	10 $\frac{1}{4}$	86,915	Apr. 14.....	160 $\frac{1}{2}$	153 $\frac{3}{4}$	7 $\frac{1}{4}$	37,813
Feb. 13.....	184 $\frac{1}{2}$	177 $\frac{1}{2}$	7	70,691	Apr. 15.....	161 $\frac{1}{2}$	151 $\frac{1}{2}$	10	46,073
Feb. 17.....	184 $\frac{3}{4}$	179 $\frac{3}{4}$	5	54,813	Apr. 16.....	152	144	8	48,157
Mar. 2.....	202	196 $\frac{3}{8}$	5 $\frac{5}{8}$	59,893	Apr. 17.....	151 $\frac{3}{4}$	144 $\frac{3}{4}$	7	36,022
Mar. 4.....	198 $\frac{3}{8}$	191 $\frac{1}{2}$	6 $\frac{5}{8}$	70,205	Apr. 18.....	151 $\frac{3}{4}$	146 $\frac{3}{4}$	5	21,471
Mar. 6.....	190 $\frac{1}{2}$	180	10 $\frac{1}{2}$	94,138	Apr. 20.....	151 $\frac{3}{4}$	142 $\frac{1}{2}$	8 $\frac{3}{4}$	31,289
Mar. 7.....	185	177	8	64,166	Apr. 22.....	156 $\frac{3}{4}$	149 $\frac{1}{2}$	7 $\frac{1}{4}$	22,984
Mar. 10.....	189 $\frac{1}{4}$	183 $\frac{3}{4}$	5 $\frac{1}{2}$	62,171	Apr. 23.....	156 $\frac{1}{4}$	151 $\frac{1}{4}$	5	17,400
Mar. 11.....	186	180 $\frac{1}{4}$	5 $\frac{3}{4}$	63,575	Apr. 28.....	149 $\frac{3}{4}$	144 $\frac{1}{2}$	5 $\frac{1}{4}$	12,348
Mar. 13.....	179 $\frac{1}{2}$	166 $\frac{1}{4}$	13 $\frac{1}{4}$	106,300	Apr. 29.....	152 $\frac{1}{4}$	147 $\frac{1}{4}$	5	13,004
Mar. 14.....	171 $\frac{1}{4}$	162	9 $\frac{1}{4}$	51,876	Apr. 30.....	155	150	5	15,390
Mar. 16.....	172 $\frac{3}{4}$	164 $\frac{1}{2}$	8 $\frac{1}{4}$	56,823	May 1.....	161 $\frac{1}{2}$	154 $\frac{1}{2}$	7	13,741
Mar. 17.....	161	151	10	95,128	May 6.....	166 $\frac{1}{2}$	160	6 $\frac{1}{2}$	5,288
Mar. 18.....	164	158 $\frac{1}{2}$	5 $\frac{1}{2}$	52,750	May 11.....	165 $\frac{1}{2}$	159 $\frac{1}{2}$	6	2,666
Mar. 20.....	168 $\frac{1}{4}$	158 $\frac{1}{2}$	9 $\frac{3}{4}$	48,161	May 12.....	163	156 $\frac{3}{4}$	6 $\frac{1}{4}$	2,721
Mar. 23.....	171	165	6	44,852	May 14.....	168 $\frac{1}{2}$	162 $\frac{1}{2}$	6	3,382
Mar. 24.....	170 $\frac{3}{4}$	165 $\frac{1}{4}$	5 $\frac{1}{2}$	35,789	May 18.....	174 $\frac{1}{4}$	169	5 $\frac{1}{4}$	4,700
Mar. 26.....	169 $\frac{1}{2}$	164 $\frac{1}{2}$	5	35,385	May 19.....	170 $\frac{3}{4}$	163 $\frac{1}{4}$	7 $\frac{1}{2}$	3,980
					May 29.....	171	165	6	3,755

TABLE 8.—*Special accounts: Number of accounts and the number of bushels of wheat "long" or "short" at the end of each month during period of July 31, 1924, to June 30, 1925, compared to the total customers' open interest in all futures on the same dates*

Date	Total customers' open interest in bushels (000 omitted)	Number of accounts		Open interest			
				Number of bushels		Per cent of total customers' open interest	
		Long	Short	Long	Short	Long	Short
1924							
July 31.....	98,453	16	16	15,121	24,469	21.54	24.85
Aug. 30.....	108,179	17	20	14,659	37,820	13.55	34.96
Sept. 30.....	103,928	24	24	21,754	31,848	20.93	30.64
Oct. 31.....	109,642	17	36	18,410	42,524	16.79	38.78
Nov. 29.....	132,833	32	44	38,419	52,512	28.92	39.53
Dec. 31.....	115,784	27	40	27,633	40,656	23.87	35.11
1925							
Jan. 31.....	113,636	24	31	25,935	28,782	22.82	25.33
Feb. 28.....	113,457	31	31	31,420	27,248	27.69	24.02
Mar. 31.....	97,591	13	22	12,112	26,865	12.41	27.53
Apr. 30.....	83,384	19	14	21,755	11,717	26.09	14.05
May 29.....	96,771	27	23	25,720	19,900	26.58	20.56
June 30.....	93,179	21	21	19,974	30,311	21.44	32.53
Total.....	1,266,837	-----	-----	272,912	374,652	21.54	29.57

TABLE 9.—*Special accounts: Number of accounts and the number of bushels of corn "long" or "short" at the end of each month during period of July 31, 1924, to June 30, 1925, compared to the total customers' open interests in all futures on the same dates*

Date	Total customers' open interest in bushels (000 omitted)	Number of accounts		Open interest			
				Number of bushels		Per cent of total customers' open interest	
		Long	Short	Long	Short	Long	Short
1924							
July 31-----	49,597	7	6	4,900	4,390	9.88	8.85
Aug. 30-----	53,082	7	4	4,925	3,240	9.28	6.10
Sept. 30-----	56,087	3	5	3,400	4,535	6.06	8.09
Oct. 31-----	63,949	12	5	8,327	6,055	13.02	9.47
Nov. 29-----	67,796	14	9	13,970	7,857	20.61	11.59
Dec. 31-----	70,409	8	7	6,382	14,602	9.06	20.74
1925							
Jan. 31-----	78,747	9	12	6,460	18,208	8.20	23.12
Feb. 28-----	86,622	11	8	10,750	16,007	12.41	18.48
Mar. 31-----	76,323	3	10	4,395	18,740	5.76	24.55
Apr. 30-----	59,493	3	11	3,580	17,011	6.02	28.59
May 29-----	58,492	3	10	1,975	12,932	3.38	22.11
June 30-----	46,865	4	8	4,085	8,321	8.72	17.76
Total-----	767,462	-----	-----	73,149	131,898	9.53	17.19

TABLE 10.—*Special accounts: Number of accounts and the number of bushels of oats "long" or "short" at the end of each month during period of July 31, 1924, to June 30, 1925, compared to the total customers' open interests in all futures on the same dates*

Date	Total customers' open in- terest in bushels (000 omitted)	Number of accounts		Open interest			
				Number of bushels		Per cent of total customers' open interest	
		Long	Short	Long	Short	Long	Short
1924							
July 31-----	30,475	5	3	4,440	4,000	14.57	13.13
Aug. 31-----	43,921	7	4	4,438	2,875	10.10	6.55
Sept. 30-----	61,832	12	18	6,905	21,050	11.17	34.04
Oct. 31-----	73,440	10	22	8,270	31,220	11.26	42.51
Nov. 29-----	79,476	17	28	14,887	42,963	18.73	54.06
Dec. 31-----	97,630	25	29	23,218	55,368	23.78	56.71
1925							
Jan. 31-----	111,550	23	29	24,137	52,337	21.64	46.92
Feb. 28-----	108,990	25	27	25,838	48,844	23.71	44.82
Mar. 31-----	78,415	12	22	11,175	36,605	14.25	46.68
Apr. 30-----	51,502	7	11	7,235	22,460	14.05	43.61
May 29-----	37,813	5	7	4,460	13,279	11.79	35.12
June 30-----	37,807	6	12	4,617	13,476	12.21	35.64
Total-----	812,841	-----	-----	139,620	344,477	17.18	42.38

TABLE 11.—*Special accounts: Number of accounts and the number of bushels of rye "long" or "short" at the end of each month during period of July 31, 1924, to June 30, 1925, compared to the total customers' open interests in all futures on the same dates*

Date	Total customers' open interest in bushels (000 omitted)	Number of accounts		Open interest			
				Number of bushels		Per cent of total customers' open interest	
		Long	Short	Long	Short	Long	Short
1924							
July 31-----	21,284	10	13	4,295	9,521	20.18	44.73
Aug. 30-----	24,124	9	12	6,500	12,411	26.94	51.45
Sept. 30-----	19,601	11	8	7,705	6,306	39.31	32.17
Oct. 31-----	26,269	10	16	9,460	12,310	36.01	46.86
Nov. 29-----	29,568	11	18	14,655	17,277	49.56	58.43
Dec. 31-----	22,991	11	11	8,390	10,654	36.49	46.34
1925							
Jan. 31-----	22,872	9	13	6,835	9,486	29.88	41.47
Feb. 28-----	21,966	8	13	6,820	8,538	31.05	38.87
Mar. 31-----	17,739	3	7	4,800	8,555	27.06	48.23
Apr. 30-----	14,874	3	4	4,805	6,592	32.30	44.32
May 29-----	6,941	1	4	220	2,360	3.17	34.00
June 30-----	8,840	1	5	255	2,333	2.88	26.39
Total-----	237,069	-----	-----	74,740	106,343	31.53	44.86

TABLE 12.—A comparison of the volume of trading in September, December, and May futures in various grains with the total volume of trades settled by notices passed, deliveries, and the actual amount of grain involved.

[Thousands of bushels; i. e., 000 omitted]

Grain and future	Total sold during life of future	Total volume settled by notices passed	Volume of grain futures settled by delivery		Total actual grain delivered	Ratio of total number of bushels sold during life of future to number of bushels actually delivered	Ratio of volume of futures settled by delivery to total number of bushels of grain actually delivered
			Bushels	Percentage of total bushels sold during life of future			
WHEAT							
	<i>Bushels</i>	<i>Bushels</i>			<i>Bushels</i>		
September, 1924..	1,838,308	34,254	12,018	0.65	2,895	635	4.15
December, 1924..	2,862,926	23,982	8,106	.28	4,701	609	1.72
May, 1925.....	7,733,848	25,574	7,645	.10	2,479	3,120	3.08
Total.....	12,435,082	83,810	27,769	.22	10,075	1,234	2.76
CORN							
September, 1924..	642,564	13,077	2,325	.36	741	867	3.14
December, 1924..	1,625,889	12,038	2,210	.14	1,346	1,208	1.64
May, 1925.....	3,152,171	20,210	6,397	.20	2,738	1,151	2.34
Total.....	5,420,624	45,325	10,932	.20	4,825	1,123	2.27
OATS							
September, 1924..	237,944	12,871	4,251	1.79	1,230	193	3.46
December, 1924..	451,707	12,327	5,524	1.22	2,033	222	2.72
May, 1925.....	1,575,463	10,662	5,559	.35	3,570	441	1.56
Total.....	2,265,114	35,860	15,334	.68	6,833	331	2.24
RYE							
September, 1924..	109,026	8,213	4,063	3.73	1,673	65	2.43
December, 1924..	285,807	9,111	8,869	3.10	7,090	40	1.25
May, 1925.....	531,191	9,184	6,587	1.24	4,641	114	1.42
Total.....	926,024	26,508	19,519	2.11	13,404	69	1.46

TABLE 13.—Daily range in price in cents per bushel of May wheat at Liverpool, Chicago, and Winnipeg, November 12, 1924, to May 21, 1925

		Liverpool	Chicago	Winnipeg		Liverpool	Chicago	Winnipeg
		<i>Cents</i>	<i>Cents</i>	<i>Cents</i>		<i>Cents</i>	<i>Cents</i>	<i>Cents</i>
Nov. 1924	13.....	1 $\frac{1}{8}$	2 $\frac{5}{8}$	3 $\frac{1}{4}$	Dec. 1924	10.....	1 $\frac{5}{8}$	1 $\frac{3}{4}$
	14.....	1 $\frac{3}{4}$	4 $\frac{1}{4}$	4 $\frac{3}{8}$		11.....	1 $\frac{5}{8}$	1 $\frac{3}{4}$
	15.....	1 $\frac{1}{4}$	2 $\frac{3}{4}$	3 $\frac{1}{4}$		12.....	1 $\frac{1}{4}$	3 $\frac{1}{8}$
	17.....	3 $\frac{1}{4}$	2 $\frac{1}{4}$	3 $\frac{1}{4}$		13.....	1 $\frac{1}{8}$	2 $\frac{1}{4}$
	18.....	1 $\frac{3}{4}$	2 $\frac{1}{4}$	3		15.....	1 $\frac{1}{2}$	1 $\frac{1}{8}$
	19.....	2 $\frac{1}{4}$	2 $\frac{1}{8}$	2 $\frac{1}{4}$		16.....	1 $\frac{1}{8}$	2
	20.....	2 $\frac{3}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{4}$		17.....	1 $\frac{1}{8}$	3 $\frac{1}{8}$
	21.....	2	1 $\frac{1}{4}$	1 $\frac{1}{8}$		18.....	1 $\frac{1}{4}$	2 $\frac{1}{4}$
	22.....	3 $\frac{1}{8}$	3 $\frac{1}{4}$	3 $\frac{1}{4}$		19.....	3 $\frac{1}{2}$	4 $\frac{1}{8}$
	24.....	1 $\frac{1}{2}$	2 $\frac{1}{8}$	2 $\frac{1}{8}$		20.....	1 $\frac{1}{8}$	3 $\frac{1}{8}$
	25.....	1 $\frac{1}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{8}$		22.....	4 $\frac{1}{4}$	5 $\frac{1}{4}$
	26.....	1 $\frac{1}{8}$	2 $\frac{1}{4}$	2 $\frac{1}{4}$		23.....	1 $\frac{1}{8}$	2 $\frac{1}{8}$
	27.....	1 $\frac{1}{8}$				24.....	1	4
	28.....	2 $\frac{1}{4}$	2	2 $\frac{1}{8}$		26.....	5 $\frac{1}{8}$	5 $\frac{1}{8}$
	29.....	3 $\frac{1}{2}$	1 $\frac{1}{4}$	1 $\frac{1}{8}$		27.....	1 $\frac{1}{8}$	4
	1.....	1 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$		29.....	3 $\frac{1}{2}$	3 $\frac{1}{2}$
	2.....	1 $\frac{1}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{2}$		30.....	1 $\frac{1}{2}$	4 $\frac{1}{4}$
	3.....	1	3	3 $\frac{1}{8}$		31.....	2 $\frac{1}{8}$	4 $\frac{1}{4}$
	4.....	1 $\frac{1}{2}$	2	1 $\frac{1}{4}$	1925			
	5.....	3 $\frac{1}{2}$	2	1 $\frac{1}{2}$				
	6.....	1 $\frac{1}{2}$	1 $\frac{1}{4}$	1 $\frac{1}{4}$				
	8.....	1 $\frac{1}{4}$	1 $\frac{1}{4}$	1 $\frac{1}{8}$				
	9.....	1 $\frac{1}{8}$	2 $\frac{1}{8}$	1 $\frac{1}{4}$				
Dec.	1.....	1 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	Jan. 1925	2.....	3 $\frac{1}{4}$	4 $\frac{1}{8}$
	2.....	1 $\frac{1}{8}$	2 $\frac{1}{8}$	2 $\frac{1}{2}$		3.....	1 $\frac{1}{8}$	2 $\frac{1}{2}$
	3.....	1	3	3 $\frac{1}{8}$				

TABLE 13.—Daily range in price in cents per bushel of May wheat at Liverpool, Chicago, and Winnipeg, November 12, 1924, to May 21, 1925—Continued

	Liver- pool	Chicago	Winni- peg		Liver- pool	Chicago	Winni- peg
Jan. 1925	Cents	Cents	Cents	Mar. 1925	Cents	Cents	Cents
5.-----	1 $\frac{7}{8}$	3 $\frac{1}{2}$	3 $\frac{1}{4}$	16.-----	9	8 $\frac{3}{4}$	6 $\frac{1}{2}$
6.-----	1 $\frac{7}{8}$	4 $\frac{1}{2}$	2 $\frac{3}{4}$	17.-----	6 $\frac{7}{8}$	10	13 $\frac{1}{2}$
7.-----	1 $\frac{7}{8}$	2 $\frac{7}{8}$	2 $\frac{7}{8}$	18.-----	12 $\frac{7}{8}$	5 $\frac{1}{2}$	5 $\frac{1}{4}$
8.-----	1 $\frac{3}{4}$	2 $\frac{7}{8}$	2	19.-----	2 $\frac{3}{4}$	3 $\frac{1}{2}$	2 $\frac{7}{8}$
9.-----	1 $\frac{3}{4}$	1 $\frac{7}{8}$	1 $\frac{1}{2}$	20.-----	4 $\frac{3}{4}$	9 $\frac{3}{4}$	11 $\frac{1}{8}$
10.-----	1	2 $\frac{3}{4}$	1 $\frac{7}{8}$	21.-----	1 $\frac{7}{8}$	4 $\frac{3}{4}$	5 $\frac{1}{4}$
12.-----	1 $\frac{7}{8}$	4 $\frac{3}{4}$	4	23.-----	3 $\frac{3}{8}$	6	5 $\frac{1}{2}$
13.-----	1 $\frac{3}{8}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	24.-----	3 $\frac{1}{2}$	5 $\frac{1}{2}$	4 $\frac{3}{4}$
14.-----	1 $\frac{1}{8}$	2 $\frac{3}{4}$	2 $\frac{7}{8}$	25.-----	3 $\frac{7}{8}$	4 $\frac{3}{4}$	4 $\frac{1}{2}$
15.-----	2 $\frac{1}{8}$	3 $\frac{3}{8}$	3	26.-----	1 $\frac{1}{4}$	5	4 $\frac{1}{2}$
16.-----	1 $\frac{3}{4}$	3 $\frac{3}{4}$	3	27.-----	1 $\frac{7}{8}$	8 $\frac{3}{4}$	9 $\frac{1}{4}$
17.-----	5 $\frac{5}{8}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$	28.-----	1 $\frac{1}{8}$	4 $\frac{1}{2}$	5 $\frac{1}{8}$
19.-----	1	2 $\frac{1}{4}$	2	30.-----	4 $\frac{1}{8}$	13 $\frac{1}{2}$	15 $\frac{1}{2}$
20.-----	3 $\frac{1}{4}$	3	2 $\frac{1}{4}$	31.-----	3 $\frac{3}{8}$	7 $\frac{1}{2}$	7 $\frac{3}{4}$
21.-----	3 $\frac{1}{2}$	3 $\frac{7}{8}$	2 $\frac{3}{4}$	Apr. 1.-----	2 $\frac{7}{8}$	3	3
22.-----	1	4 $\frac{1}{8}$	2 $\frac{3}{4}$	2.-----	6 $\frac{7}{8}$	5	6
23.-----	1 $\frac{3}{8}$	2 $\frac{7}{8}$	3	3.-----	6	8 $\frac{1}{2}$	9
24.-----	3 $\frac{1}{4}$	3 $\frac{1}{4}$	3 $\frac{1}{8}$	4.-----	2	6	8 $\frac{3}{4}$
26.-----	2 $\frac{1}{8}$	2 $\frac{7}{8}$	2 $\frac{1}{2}$	6.-----	2 $\frac{1}{8}$	3 $\frac{3}{4}$	4 $\frac{1}{8}$
27.-----	3 $\frac{1}{2}$	3 $\frac{3}{4}$	5 $\frac{1}{8}$	7.-----	2 $\frac{5}{8}$	4 $\frac{3}{4}$	5
28.-----	3	6 $\frac{1}{8}$	7 $\frac{7}{8}$	8.-----	3	3 $\frac{1}{2}$	4
29.-----	6 $\frac{1}{4}$	4 $\frac{1}{2}$	10	9.-----	1 $\frac{1}{8}$	5	5 $\frac{5}{8}$
30.-----	2 $\frac{3}{8}$	3 $\frac{1}{2}$	4 $\frac{1}{4}$	11.-----	2 $\frac{3}{4}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$
31.-----	1 $\frac{3}{8}$	2 $\frac{7}{8}$	2 $\frac{1}{8}$	13.-----	5 $\frac{1}{4}$	5 $\frac{1}{4}$	6 $\frac{1}{8}$
Feb. 2.-----	2 $\frac{1}{4}$	3 $\frac{1}{4}$	6	14.-----	1 $\frac{3}{4}$	7 $\frac{1}{4}$	9
3.-----	3 $\frac{1}{8}$	4 $\frac{1}{8}$	7 $\frac{1}{2}$	15.-----	7 $\frac{7}{8}$	10	8 $\frac{1}{4}$
4.-----	3 $\frac{5}{8}$	2	3 $\frac{3}{4}$	16.-----	7 $\frac{7}{8}$	8	9 $\frac{1}{8}$
5.-----	4 $\frac{1}{2}$	5 $\frac{3}{8}$	6 $\frac{7}{8}$	17.-----	2 $\frac{3}{4}$	7	8 $\frac{3}{8}$
6.-----	3 $\frac{7}{8}$	9 $\frac{3}{4}$	2	18.-----	1 $\frac{1}{4}$	5	3 $\frac{1}{8}$
7.-----	2	4 $\frac{1}{2}$	8	20.-----	1 $\frac{7}{8}$	8 $\frac{3}{4}$	7 $\frac{7}{8}$
9.-----	2 $\frac{1}{2}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	21.-----	3 $\frac{1}{2}$	4 $\frac{3}{4}$	5 $\frac{1}{4}$
10.-----	2 $\frac{3}{4}$	5 $\frac{1}{4}$	4 $\frac{1}{2}$	22.-----	3	7 $\frac{1}{4}$	5 $\frac{5}{8}$
11.-----	3	10 $\frac{1}{4}$	12 $\frac{3}{8}$	23.-----	1 $\frac{7}{8}$	5	4
12.-----	3 $\frac{3}{8}$	-----	-----	24.-----	1 $\frac{1}{2}$	3 $\frac{3}{4}$	3 $\frac{7}{8}$
13.-----	4 $\frac{1}{8}$	7	7 $\frac{7}{8}$	25.-----	1 $\frac{1}{4}$	3 $\frac{1}{4}$	2 $\frac{7}{8}$
14.-----	2	4 $\frac{1}{2}$	5 $\frac{1}{4}$	27.-----	1 $\frac{3}{4}$	4	3 $\frac{1}{4}$
16.-----	1 $\frac{1}{8}$	4 $\frac{1}{2}$	4 $\frac{3}{8}$	28.-----	3	5 $\frac{1}{4}$	4 $\frac{1}{8}$
17.-----	4 $\frac{1}{4}$	5	4	29.-----	3 $\frac{3}{8}$	5	4 $\frac{3}{4}$
18.-----	2 $\frac{1}{8}$	3 $\frac{7}{8}$	3 $\frac{1}{2}$	30.-----	1 $\frac{1}{2}$	5	5 $\frac{1}{4}$
19.-----	3 $\frac{5}{8}$	2 $\frac{1}{4}$	2	May 1.-----	5 $\frac{3}{4}$	7	6 $\frac{1}{2}$
20.-----	3 $\frac{1}{4}$	2 $\frac{7}{8}$	2 $\frac{3}{4}$	2.-----	1 $\frac{1}{8}$	3 $\frac{1}{4}$	3 $\frac{3}{4}$
21.-----	1 $\frac{7}{8}$	3 $\frac{3}{4}$	3 $\frac{1}{2}$	4.-----	7 $\frac{7}{8}$	3 $\frac{3}{4}$	-----
23.-----	1 $\frac{1}{8}$	-----	-----	5.-----	2 $\frac{3}{4}$	2 $\frac{1}{4}$	2 $\frac{1}{8}$
24.-----	1 $\frac{1}{4}$	2	2	6.-----	2 $\frac{1}{2}$	6 $\frac{1}{2}$	8 $\frac{3}{4}$
25.-----	2 $\frac{5}{8}$	3 $\frac{1}{2}$	2 $\frac{7}{8}$	7.-----	5 $\frac{5}{8}$	4 $\frac{1}{4}$	6 $\frac{1}{4}$
26.-----	2	4 $\frac{1}{4}$	4	8.-----	7 $\frac{7}{8}$	3 $\frac{1}{4}$	4 $\frac{3}{8}$
27.-----	1 $\frac{1}{8}$	3 $\frac{3}{8}$	2 $\frac{1}{4}$	9.-----	1 $\frac{1}{8}$	4	7
28.-----	1 $\frac{5}{8}$	5 $\frac{1}{8}$	4 $\frac{3}{8}$	11.-----	3 $\frac{3}{8}$	6	5 $\frac{3}{4}$
Mar. 2.-----	2	5 $\frac{3}{8}$	4 $\frac{3}{8}$	12.-----	7 $\frac{7}{8}$	6 $\frac{1}{4}$	5 $\frac{3}{4}$
3.-----	1 $\frac{7}{8}$	2 $\frac{1}{4}$	2 $\frac{7}{8}$	13.-----	1 $\frac{1}{2}$	3 $\frac{3}{4}$	4 $\frac{3}{8}$
4.-----	2 $\frac{1}{4}$	6 $\frac{1}{8}$	5 $\frac{7}{8}$	14.-----	-----	6	5 $\frac{3}{4}$
5.-----	1 $\frac{1}{2}$	4 $\frac{1}{4}$	10 $\frac{1}{2}$	15.-----	5 $\frac{5}{8}$	3	2 $\frac{1}{2}$
6.-----	5	10 $\frac{1}{2}$	10 $\frac{1}{4}$	16.-----	1 $\frac{1}{4}$	4 $\frac{3}{4}$	3 $\frac{3}{4}$
7.-----	1 $\frac{3}{4}$	8	8 $\frac{3}{4}$	18.-----	1 $\frac{7}{8}$	5 $\frac{3}{4}$	7 $\frac{5}{8}$
9.-----	3 $\frac{7}{8}$	2 $\frac{5}{8}$	3 $\frac{1}{2}$	19.-----	7 $\frac{7}{8}$	7 $\frac{1}{2}$	8 $\frac{3}{8}$
10.-----	3 $\frac{7}{8}$	5 $\frac{1}{2}$	6 $\frac{1}{2}$	20.-----	5 $\frac{5}{8}$	2 $\frac{1}{4}$	2 $\frac{1}{8}$
11.-----	3 $\frac{3}{8}$	5 $\frac{1}{4}$	4 $\frac{3}{8}$	21.-----	5 $\frac{5}{8}$	2 $\frac{1}{4}$	5 $\frac{1}{2}$
12.-----	4	3 $\frac{1}{2}$	3 $\frac{1}{2}$	Average daily range	2.20	4.43	4.65
13.-----	5 $\frac{3}{4}$	13 $\frac{1}{4}$	12 $\frac{1}{2}$				
14.-----	4 $\frac{1}{8}$	9 $\frac{1}{4}$	10				

TABLE 14.—Daily range of price in cents per bushel of May wheat at Winnipeg and Chicago, January 2, 1914, to May 20, 1914

		Winnipeg	Chicago			Winnipeg	Chicago
1914		Cents	Cents	1914		Cents	Cents
Jan.	2	1/2	3/4	Mar.	14	1/4	1/2
	3	5/8	5/8		16	3/8	1/2
	4	5/8	5/8		17	1/2	1/2
	5	5/8	5/8		18	1/4	1/2
	6	5/8	5/8		19	1/4	1/2
	7	1/2	3/4		20	5/8	1
	8	3/8	5/8		21	1/2	1/2
	9	1/4	5/8		22	1/4	5/8
	10	1/4	1/2		23	5/8	5/8
	11	3/8	1/2		24	5/8	5/8
	12	3/8	1/2		25	5/8	5/8
	13	1/4	1/2		26	5/8	5/8
	14	5/8	3/4		27	5/8	5/8
	15	5/8	5/8		28	5/8	5/8
	16	1/2	5/8		29	5/8	5/8
	17	5/8	5/8		30	1/4	5/8
	18	1/2	1/2		31	1/6	1/6
	19	1/2	1/2	Apr.	1	5/8	5/8
	20	5/8	1/2		2	1	5/8
	21	1/2	1/2		3	1/2	5/8
	22	5/8	7/8		4	5/8	1/2
	23	5/8	1		5	5/8	1/2
	24	1/4	3/4		6	5/8	1/2
	25	3/8	5/8		7	5/8	5/8
	26	3/8	5/8		8	5/8	5/8
	27	1/2	1/2		9	5/8	5/8
	28	3/8	5/8		10	1/4	1/6
	29	5/8	1		11	3/4	1
	30	3/4	5/8		12	11/16	11/16
	31	1/4	3/8		13	1/2	3/4
Feb.	2	5/8	5/8		14	5/8	1
	3	3/4	3/4		15	5/8	3/4
	4	1/4	5/8		16	1	1
	5	3/8	3/8		17	1/4	3/4
	6	1/8	1/2		18	5/8	5/8
	7	1/4	1/2		19	5/8	5/8
	8	1/4	1/2		20	5/8	5/8
	9	3/8	1/2		21	5/8	5/8
	10	1/2	5/8		22	1	17/8
	11	5/8	5/8		23	1/2	1
	12	5/8	5/8		24	1/2	1/2
	13	5/8	5/8		25	5/8	5/8
	14	1/8	1/4		26	1/2	5/8
	15	1/4	3/8		27	1/2	5/8
Mar.	16	1/4	3/8		28	1/2	5/8
	17	5/8	3/4		29	1	5/8
	18	1/2	5/8	May	30	1/2	5/8
	19	7/8	5/8		1	5/8	5/8
	20	1/2	1/2		2	5/4	1
	21	1/2	3/8		3	1	1
	22	3/8	3/4		4	1	1
	23	3/8	3/4		5	1/2	3/4
	24	1/2	1/2		6	5/8	1/2
	25	1/4	1/2		7	5/8	5/8
	26	1/4	1/2		8	1/2	1/2
	27	1/2	1/2		9	1/6	1/4
	28	3/8	3/8		10	5/8	1
	29	1/2	1/2		11	5/8	5/8
	30	1/2	1/2		12	5/8	5/8
	31	1	1		13	5/8	5/8
Mar.	2	1/2	1/2		14	5/8	17/8
	3	1	1		15	5/8	1
	4	1/2	1/2		16	5/8	21/8
	5	7/8	3/4		17	5/8	5/8
	6	5/8	5/8		18	5/8	5/8
	7	5/8	5/8		19	5/8	5/8
	8	1/2	5/8		20	5/4	5/8
	9	1	1/4		21	5/4	17/8
	10	1/2	1/2	Average daily range		0.50	0.68
	11	1/2	1/2				
	12	1/2	5/8				
	13	3/4	3/4				

TABLE 15.—*Grain futures: Volume of trading in 9 markets combined, by grains, and for all grains combined, by months with totals, by quarters, and by calendar years, July 1, 1924, to June 30, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Month	Wheat futures	Corn futures	Oats futures	Rye futures	Barley futures	Flax futures	All grain futures
1924							
July.....	1,332,783	565,183	163,604	108,006	1,355	1,701	2,172,632
August.....	1,300,274	740,110	265,770	103,147	3,467	2,311	2,415,079
September.....	1,068,376	694,813	195,278	148,263	5,764	6,734	2,119,228
Quarter.....	3,701,433	2,000,106	624,652	359,416	10,586	10,746	6,706,939
October.....							
November.....	1,595,625	677,597	328,323	159,360	4,402	21,102	2,786,409
December.....	1,339,724	557,384	203,696	111,451	4,636	16,180	2,233,071
Quarter.....	1,528,037	706,556	401,240	99,043	3,807	6,379	2,745,062
Quarter.....	4,463,386	1,941,537	933,259	369,854	12,845	43,661	7,764,542
1925							
January.....	1,907,786	709,340	355,085	115,396	2,614	3,627	3,093,848
February.....	1,781,067	677,271	347,524	90,993	2,870	3,611	2,903,336
March.....	2,273,190	810,449	346,493	117,174	3,077	2,501	3,552,884
Quarter.....	5,962,043	2,197,060	1,049,102	323,563	8,561	9,739	9,550,068
April.....	1,482,192	669,696	259,566	75,998	3,075	2,341	2,492,868
May.....	1,508,037	510,295	154,091	48,149	1,628	1,621	2,223,821
June.....	1,758,880	565,916	297,437	51,777	1,931	2,017	2,677,958
Quarter.....	4,749,109	1,745,907	711,094	175,924	6,634	5,979	7,394,647
Total.....	18,875,971	7,884,610	3,318,107	1,228,757	38,626	70,125	31,416,196

TABLE 16.—*Grain futures: Volume of trading at 9 markets, by markets, by months and by grains, for the period July 1, 1924, to June 30, 1925*

[In thousands of bushels; i. e., 000 omitted]

Month and market	Wheat futures	Corn futures	Oats futures	Rye futures	Barley futures	Flax futures	All grain futures
1924							
July:							
Chicago.....	1,184,022	531,131	156,117	90,826	-----	-----	1,962,096
Chicago Open Board.....	34,279	10,733	637	50	-----	-----	45,699
Minneapolis.....	46,726	-----	5,993	10,026	738	388	63,871
Kansas City.....	44,787	18,800	58	-----	-----	-----	63,645
Duluth.....	¹ 9,150	-----	-----	6,837	-----	1,313	17,300
St. Louis.....	12,182	2,812	-----	-----	-----	-----	14,994
Milwaukee.....	1,637	1,707	799	267	-----	-----	4,410
San Francisco.....	-----	-----	-----	-----	592	-----	592
Los Angeles.....	-----	-----	-----	-----	25	-----	25
Total.....	1,332,783	565,183	163,604	108,006	1,355	1,701	2,172,632
August:							
Chicago.....	1,135,270	692,910	249,299	80,830	-----	-----	2,158,309
Chicago Open Board.....	32,276	15,585	1,422	44	-----	-----	49,327
Minneapolis.....	61,038	-----	13,679	11,275	3,263	520	89,775
Kansas City.....	48,297	26,165	46	-----	-----	-----	74,508
Duluth.....	¹ 12,775	-----	-----	10,747	-----	1,791	25,313
St. Louis.....	9,473	3,247	-----	-----	-----	-----	12,820
Milwaukee.....	1,145	2,103	1,324	251	-----	-----	4,823
San Francisco.....	-----	-----	-----	-----	187	-----	187
Los Angeles.....	-----	-----	-----	-----	17	-----	17
Total.....	1,300,274	740,110	265,770	103,147	3,467	2,311	2,415,079

¹ Durum wheat.

TABLE 16.—*Grain futures: Volume of trading at 9 markets, by markets, by months and by grains, for the period July 1, 1924, to June 30, 1925—Continued*

[In thousands of bushels; i. e., 000 omitted]

Month and market	Wheat futures	Corn futures	Oats futures	Rye futures	Barley futures	Flax futures	All grain futures
1924							
September:							
Chicago	891,432	650,829	171,897	111,420			1,825,578
Chicago Open Board							
Board	26,896	15,822	693	103			43,514
Minneapolis	80,926		21,282	10,530	5,285	1,406	119,429
Kansas City	32,516	22,646	74				55,236
Duluth	² 28,910			25,890		5,328	60,128
St. Louis	6,791	3,698					10,489
Milwaukee	905	1,818	1,332	320			4,375
San Francisco					446		446
Los Angeles					33		33
Total	1,068,376	694,813	195,278	148,263	5,764	6,734	2,119,228
October:							
Chicago	1,352,496	632,525	298,161	128,573			2,411,755
Chicago Open Board							
Board	39,223	15,335	2,072	503			57,133
Minneapolis	106,981		26,057	8,419	3,798	3,142	148,397
Kansas City	44,423	23,012	229				67,664
Duluth	² 38,064			21,277		17,960	77,301
St. Louis	12,284	4,737					17,021
Milwaukee	2,154	1,988	1,804	588			6,534
San Francisco					583		583
Los Angeles					21		21
Total	1,595,625	677,597	328,323	159,360	4,402	21,102	2,786,409
November:							
Chicago	1,118,467	516,003	175,346	88,829			1,898,645
Chicago Open Board							
Board	34,405	11,715	1,135	286			47,541
Minneapolis	101,110		25,437	7,409	3,907	2,652	140,515
Kansas City	45,567	23,074	198				68,839
Duluth	² 27,630			14,616		13,528	55,774
St. Louis	10,592	5,101					15,693
Milwaukee	1,953	1,491	1,580	311			5,335
San Francisco					729		729
Total	1,339,724	557,384	203,696	111,451	4,636	16,180	2,233,071
December:							
Chicago	1,335,088	651,255	372,404	85,146			2,443,893
Chicago Open Board							
Board	40,747	12,420	3,017	348			56,532
Minneapolis	75,197		23,277	4,861	3,416	2,239	108,990
Kansas City	49,138	34,448	599				84,185
Duluth	² 13,742			8,473		4,140	26,355
St. Louis	11,803	6,812					18,615
Milwaukee	2,322	1,621	1,943	215			6,101
San Francisco					308		308
Los Angeles					83		83
Total	1,528,037	706,556	401,240	99,043	3,807	6,379	2,745,062
1925							
January:							
Chicago	1,700,817	661,047	326,169	103,297			2,791,330
Chicago Open Board							
Board	47,070	12,104	2,605	255			62,034
Minneapolis	74,567		24,386	6,490	2,535	1,496	109,474
Kansas City	55,924	25,797	520				82,241
Duluth	² 12,650			5,171		2,131	19,952
St. Louis	14,303	8,769					23,072
Milwaukee	2,455	1,623	1,405	183			5,666
San Francisco					79		79
Total	1,907,786	709,340	355,085	115,306	2,614	8,627	3,093,848

² Durum and other wheat combined.

TABLE 16.—*Grain futures: Volume of trading at 9 markets, by markets, by months and by grains, for the period July 1, 1924, to June 30, 1925—Continued*

[In thousands of bushels; i. e., 000 omitted]

Month and market	Wheat futures	Corn futures	Oats futures	Rye futures	Barley futures	Flax futures	All grain futures
1925							
February:							
Chicago	1,581,584	623,717	310,444	81,501	-----	-----	2,597,246
Chicago Open							
Board	38,654	12,154	2,419	85	-----	-----	53,312
Minneapolis	75,441	-----	32,574	4,986	2,695	1,524	117,220
Kansas City	60,880	31,297	659	-----	-----	-----	92,836
Duluth	² 8,297	-----	-----	4,283	-----	2,087	14,667
St. Louis	14,284	8,449	-----	-----	-----	-----	22,733
Milwaukee	1,927	1,654	1,428	138	-----	-----	5,147
San Francisco	-----	-----	-----	-----	171	-----	171
Los Angeles	-----	-----	-----	-----	4	-----	4
Total	1,781,067	677,271	347,524	90,993	2,870	3,611	2,903,336
March:							
Chicago	2,051,895	755,197	305,093	107,321	-----	-----	3,219,506
Chicago Open							
Board	41,948	13,568	1,431	2	-----	-----	56,949
Minneapolis	86,265	-----	37,585	5,096	2,673	980	132,599
Kansas City	68,685	32,048	755	-----	-----	-----	101,488
Duluth	² 7,038	-----	-----	4,564	-----	1,521	13,123
St. Louis	14,816	7,328	-----	-----	-----	-----	22,144
Milwaukee	2,543	2,308	1,629	191	-----	-----	6,671
San Francisco	-----	-----	-----	-----	375	-----	375
Los Angeles	-----	-----	-----	-----	29	-----	29
Total	2,273,190	810,449	346,493	117,174	3,077	2,501	3,552,884
April:							
Chicago	1,311,874	622,113	219,671	62,013	-----	-----	2,215,671
Chicago Open							
Board	30,649	9,626	825	24	-----	-----	41,124
Minneapolis	80,866	-----	36,896	3,628	2,980	883	125,253
Kansas City	41,229	30,549	783	-----	-----	-----	72,561
Duluth	² 9,886	-----	-----	10,123	-----	1,458	21,467
St. Louis	6,322	5,511	-----	-----	-----	-----	11,833
Milwaukee	1,366	1,897	1,391	210	-----	-----	4,867
San Francisco	-----	-----	-----	-----	87	-----	84
Los Angeles	-----	-----	-----	-----	8	-----	8
Total	1,482,192	669,696	259,566	75,998	3,075	2,341	2,492,868
May:							
Chicago	1,347,285	477,479	138,333	41,754	-----	-----	2,004,851
Chicago Open							
Board	34,739	9,527	520	-----	-----	-----	44,786
Minneapolis	69,329	-----	14,009	2,834	1,557	485	88,214
Kansas City	39,715	20,058	167	-----	-----	-----	59,940
Duluth	² 9,338	-----	-----	3,393	-----	1,136	13,867
St. Louis	6,031	2,052	-----	-----	-----	-----	8,083
Milwaukee	1,600	1,179	1,062	168	-----	-----	4,009
San Francisco	-----	-----	-----	-----	54	-----	54
Los Angeles	-----	-----	-----	-----	17	-----	17
Total	1,508,037	510,295	154,091	48,149	1,628	1,621	2,223,821
June:							
Chicago	1,576,880	528,942	261,657	46,134	-----	-----	2,413,613
Chicago Open							
Board	45,596	10,024	1,547	-----	-----	-----	57,167
Minneapolis	69,365	-----	32,221	2,899	1,919	789	107,193
Kansas City	45,845	22,822	112	-----	-----	-----	68,779
Duluth	² 12,096	-----	-----	2,501	-----	1,228	15,825
St. Louis	7,125	2,593	-----	-----	-----	-----	9,718
Milwaukee	1,973	1,535	1,900	243	-----	-----	5,651
San Francisco	-----	-----	-----	-----	8	-----	8
Los Angeles	-----	-----	-----	-----	4	-----	4
Total	1,758,880	565,916	297,437	51,777	1,931	2,017	2,677,958

² Durum and other wheat combined.

TABLE 17.—*Grain futures: Volume of trading, by futures, during the "life" of the future, for each of the principal grains, Chicago Board of Trade, for futures expiring July, 1921, to June, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Grain and crop year	July future	September future	December future	May future	Other futures expiring during year	All futures expiring during year
Wheat:						
1921.....	2, 220, 351	1, 499, 096	2, 324, 822	-----	332	6, 044, 601
1922.....	2, 695, 392	1, 383, 957	1, 720, 916	6, 075, 842	5, 248	11, 881, 355
1923.....	2, 470, 696	1, 550, 345	1, 746, 958	3, 704, 517	1, 362	9, 473, 878
1924.....	914, 407	1, 838, 308	2, 862, 926	2, 037, 720	669	7, 654, 030
1925.....	-----	-----	-----	7, 733, 848	-----	7, 733, 848
4-year average.....	2, 075, 212	1, 567, 926	2, 163, 905	4, 887, 981	1, 904	10, 696, 923
Per cent.....	19. 40	14. 65	20. 24	45. 69	. 02	100. 00
Corn:						
1921.....	1, 436, 777	1, 179, 337	804, 613	-----	324	3, 421, 051
1922.....	771, 657	638, 235	1, 135, 402	1, 626, 666	2, 724	4, 174, 684
1923.....	1, 010, 157	722, 559	952, 758	1, 887, 005	3, 364	4, 575, 843
1924.....	572, 265	642, 655	1, 625, 889	1, 629, 643	8, 256	4, 478, 708
1925.....	-----	-----	-----	3, 152, 171	-----	3, 152, 171
4-year average.....	947, 714	795, 697	1, 129, 665	2, 073, 871	3, 667	4, 950, 614
Per cent.....	19. 15	16. 07	22. 82	41. 89	. 07	100. 00
Oats:						
1921.....	378, 424	715, 862	573, 486	-----	103	1, 667, 875
1922.....	333, 845	255, 996	271, 003	816, 447	1, 297	1, 678, 588
1923.....	174, 806	150, 346	147, 795	480, 653	895	954, 495
1924.....	91, 733	237, 944	451, 707	303, 562	545	1, 085, 491
1925.....	-----	-----	-----	1, 575, 463	-----	1, 575, 463
4-year average.....	244, 702	340, 037	360, 998	794, 031	710	1, 740, 478
Per cent.....	14. 06	19. 53	20. 75	45. 62	. 04	100. 00
Rye:						
1921.....	49, 896	31, 322	46, 410	-----	15	127, 643
1922.....	37, 222	72, 428	70, 719	88, 322	174	268, 865
1923.....	65, 170	40, 960	54, 424	184, 527	115	345, 196
1924.....	41, 494	109, 036	285, 807	88, 054	305	524, 696
1925.....	-----	-----	-----	531, 191	-----	531, 191
4-year average.....	48, 445	63, 436	114, 340	223, 024	152	449, 397
Per cent.....	10. 78	14. 12	25. 44	49. 63	. 03	100. 00

TABLE 18.—*Wheat futures: Volume of trading in each of the principal futures by months, Chicago Board of Trade, for the period July 1, 1924, to June 30, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Month	July wheat	September wheat	December wheat	May wheat	Other wheat futures	All futures
1924						
July.....	26, 539	761, 652	351, 556	44, 275	-----	1, 184, 022
August.....	2, 471	394, 962	583, 867	153, 970	-----	1, 135, 270
September.....	6, 632	40, 000	633, 923	210, 877	-----	891, 432
October.....	41, 767	-----	792, 252	518, 324	153	1, 352, 496
November.....	41, 660	-----	337, 389	739, 418	-----	1, 118, 467
December.....	116, 219	-----	51, 540	1, 167, 314	15	1, 335, 088
1925						
January.....	229, 261	41, 004	-----	1, 429, 310	1, 242	1, 700, 817
February.....	275, 881	55, 146	-----	1, 250, 557	-----	1, 581, 584
March.....	500, 089	108, 181	-----	1, 443, 625	-----	2, 051, 895
April.....	506, 520	116, 486	103	688, 765	-----	1, 311, 874
May.....	877, 955	348, 446	33, 466	87, 383	35	1, 347, 285
June.....	519, 595	805, 183	251, 712	-----	390	1, 576, 880
Total.....	3, 144, 589	2, 671, 060	3, 035, 808	7, 733, 818	1, 835	16, 587, 110

TABLE 19.—*Corn futures: Volume of trading in each of the principal futures by months, Chicago Board of Trade, for the period July 1, 1924, to June 30, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Month	December corn	May corn	July corn	September corn	Other corn futures	All futures
1924						
July.....	308, 874	47, 528	24, 525	150, 199	5	531, 131
August.....	384, 354	226, 656	2, 289	78, 558	1, 053	692, 910
September.....	353, 941	262, 159	6, 848	24, 612	3, 269	650, 829
October.....	276, 990	327, 287	26, 425	-----	1, 823	632, 525
November.....	125, 355	337, 030	53, 603	-----	15	516, 003
December.....	44, 670	494, 807	111, 229	534	15	651, 255
1925						
January.....	-----	489, 344	133, 640	37, 993	70	661, 047
February.....	5	415, 112	146, 820	61, 780	-----	623, 717
March.....	165	379, 878	261, 554	113, 600	-----	755, 197
April.....	907	152, 790	320, 674	147, 742	-----	622, 113
May.....	34, 363	19, 560	298, 694	124, 862	-----	477, 479
June.....	151, 466	26	115, 075	262, 265	110	528, 942
Total.....	1, 681, 090	3, 152, 177	1, 501, 376	1, 002, 145	6, 360	7, 343, 148

TABLE 20.—*Oats futures: Volume of trading in each of the principal futures, by months, Chicago Board of Trade, for the period July 1, 1924, to June 30, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Month	July oats	September oats	December oats	May oats	Other oats futures	All futures
1924						
July.....	7, 687	89, 946	50, 120	8, 364	-----	156, 117
August.....	-----	70, 924	139, 548	38, 827	-----	249, 299
September.....	-----	12, 235	90, 873	68, 789	-----	171, 897
October.....	3, 104	-----	106, 521	188, 406	130	298, 161
November.....	5, 423	-----	41, 648	128, 275	-----	175, 346
December.....	18, 226	5	11, 898	342, 260	15	372, 404
1925						
January.....	38, 201	24, 357	-----	263, 591	20	326, 169
February.....	59, 208	33, 721	-----	217, 515	-----	310, 444
March.....	74, 130	41, 544	-----	189, 374	45	305, 093
April.....	86, 307	28, 972	-----	104, 052	340	219, 671
May.....	68, 946	41, 030	2, 342	26, 010	5	138, 333
June.....	52, 391	150, 206	59, 025	-----	35	261, 657
Total.....	413, 623	492, 940	501, 975	1, 575, 463	590	2, 984, 591

TABLE 21.—*Rye futures: Volume of trading in each of the principal futures, by months, Chicago Board of Trade, for period July 1, 1924, to June 30, 1925*

[Volume of trading, in thousands of bushels; i. e., 000 omitted]

Month	July rye	September rye	December rye	May rye	Other rye futures	All futures
1924						
July.....	6, 619	52, 195	31, 068	944	-----	90, 826
August.....	-----	21, 475	52, 841	6, 514	-----	80, 830
September.....	-----	4, 719	84, 565	22, 136	-----	111, 420
October.....	150	-----	76, 766	51, 642	15	128, 573
November.....	852	-----	29, 222	58, 755	-----	88, 829
December.....	4, 068	125	7, 038	73, 905	10	85, 146
1925						
January.....	6, 850	477	-----	95, 915	55	103, 297
February.....	9, 007	1, 553	-----	70, 871	70	81, 501
March.....	9, 538	4, 223	-----	93, 540	20	107, 321
April.....	12, 629	4, 699	-----	44, 685	-----	62, 013
May.....	18, 274	11, 031	165	12, 284	-----	41, 754
June.....	13, 266	23, 970	8, 576	-----	322	46, 134
Total.....	81, 253	124, 467	290, 241	531, 191	492	1, 027, 644

TABLE 22.—Wheat futures: Volume of trading in each of the principal futures, by weeks, Chicago Board of Trade, for the year January 5, 1924, to June 27, 1925

[In thousands of bushels; i. e., 000 omitted]

Week ended—		December future	July future	September future	May future	Other futures	All futures
1924							
Jan.	5.	2,891	14,168	1,046	53,522	4	71,631
	12.		13,870	2,396	55,359	10	71,635
	19.		10,628	2,236	62,784		75,648
	26.		6,988	774	36,487		44,249
Feb.	2.		23,320	7,738	69,735		100,793
	9.		24,121	9,790	58,211		92,122
	16.		23,363	13,378	68,568		105,309
	23.		12,810	7,136	44,549		64,495
Mar.	1.		11,541	6,683	41,578		59,802
	8.		15,991	11,630	41,594		69,215
	15.		39,200	18,808	108,432		166,440
	22.		20,817	10,077	69,364		100,258
	29.		31,231	19,431	97,362		148,024
Apr.	5.	101	22,124	9,700	52,783		84,708
	12.	75	14,363	7,495	43,493		65,426
	19.	160	22,822	9,166	38,603		70,751
	26.	227	42,430	14,390	29,549		86,596
May	3.	655	62,850	15,631	52,499		131,635
	10.	908	49,075	12,547	7,172		69,702
	17.	996	34,830	10,552	3,715		50,093
	24.	1,367	45,668	16,735	3,358		67,128
	31.	2,498	39,371	21,289	6,355		69,513
June	7.	5,544	68,157	44,262		134	118,097
	14.	19,705	76,133	84,657		262	180,757
	21.	35,227	48,047	146,512		86	229,872
	28.	38,425	18,045	117,532		20	174,022
July	3.	24,410	11,935	82,162	979		119,486
	12.	51,120	5,642	117,323	2,513		176,598
	19.	102,567	6,039	211,871	10,127		330,604
	26.	102,269	2,492	214,510	13,541		332,812
Aug.	2.	105,905	5,566	214,176	23,653		349,300
	9.	97,946	100	125,121	20,806		243,973
	16.	117,673	395	104,848	26,390		249,306
	23.	168,425	1,308	61,635	49,004		280,372
	30.	171,619	668	45,071	51,262		268,620
Sept.	6.	116,152	707	22,489	28,726		168,074
	13.	138,091	687	10,480	43,278		192,536
	20.	134,436	1,617	2,581	45,645		184,279
	27.	171,288	2,186	2,507	60,957		236,938
Oct.	4.	211,243	6,843	1,943	113,499		335,528
	11.	210,533	12,691		131,324	153	354,701
	18.	162,034	8,614		100,768		271,419
	25.	165,716	10,316		115,677		291,709
Nov.	1.	130,416	5,634		98,980		235,030
	8.	121,239	9,593		131,358		262,190
	15.	104,466	11,173		193,143		308,782
	22.	57,869	12,231		214,438		284,538
	29.	40,081	7,767		190,826		238,674
Dec.	6.	24,747	14,701		222,155		261,603
	13.	13,565	20,698		258,107		292,370
	20.	6,943	32,437		269,461	15	308,856
	27.	3,899	28,525		244,302		276,726
1925							
Jan.	3.	2,386	28,266	712	262,767		294,131
	10.		26,540	5,977	278,442	532	311,491
	17.		42,613	8,222	360,744		411,579
	24.		74,060	11,170	336,423	30	421,683
	31.		77,640	14,923	364,223	680	457,466
Feb.	7.		87,249	19,878	415,412		522,539
	14.		63,556	14,616	335,940		414,112
	21.		50,682	7,677	265,225		323,584
	28.		74,394	12,975	233,980		321,349
Mar.	7.		144,680	25,356	388,302		558,338
	14.		115,225	25,470	374,536		515,231
	21.		92,779	26,249	331,483		450,511
	28.		101,189	19,331	233,740		354,260
Apr.	4.		109,990	33,567	249,179		392,736
	11.		74,488	20,154	156,017		250,659
	18.		128,152	28,484	222,447		379,083
	25.		135,112	26,679	117,709		279,500
May	2.	1,142	190,621	43,704	78,265		313,732
	9.	2,486	221,006	67,334	24,682		315,508
	16.	3,198	191,535	60,314	16,334		271,381
	23.	4,915	161,735	66,999	15,826		249,475
	29.	21,828	218,052	129,472	11,253	35	380,640
June	6.	45,891	213,251	146,040		220	405,402
	13.	44,559	159,170	163,450		30	367,209
	20.	64,340	83,942	215,575		70	363,927
	27.	67,431	43,911	200,318		55	311,715

TABLE 23.—*Grain futures: Customers' "open interest" (one side only), for six markets, by markets, by months, and by grains, with totals for all grains, at monthly intervals during the period July, 1924, to and including June, 1925*

[In thousands of bushels; i. e., 000 omitted]

Grain	Chicago	Minneapolis	Duluth	Kansas City	St. Louis	Milwaukee	Total
July 31, 1924:							
Wheat futures.....	98,453	9,003	1,855	7,659	1,963	163	119,096
Corn futures.....	49,597			2,733	527	252	53,109
Oats futures.....	30,475	2,056		26		241	32,798
Rye futures.....	21,284	3,047	2,141			89	26,561
Barley futures.....		300					300
Flax futures.....		220	374				594
Total.....	199,809	14,626	4,370	10,418	2,490	745	232,458
Aug. 30, 1924:							
Wheat futures.....	108,179	12,406	3,712	10,421	2,165	204	137,087
Corn futures.....	53,082			3,978	677	367	58,104
Oats futures.....	43,921	4,255		51		400	48,627
Rye futures.....	24,124	3,757	2,493			81	30,455
Barley futures.....		1,464					1,464
Flax futures.....		411	931				1,342
Total.....	229,306	22,293	7,136	14,450	2,842	1,052	277,079
Sept. 30, 1924:							
Wheat futures.....	103,928	14,802	5,718	11,050	2,268	196	137,962
Corn futures.....	56,087			4,864	932	305	62,188
Oats futures.....	61,832	8,214		65		579	70,690
Rye futures.....	19,601	1,809	2,745			105	24,260
Barley futures.....		1,153					1,153
Flax futures.....		376	1,585				1,961
Total.....	241,448	26,354	10,048	15,979	3,200	1,185	298,214
Oct. 31, 1924:							
Wheat futures.....	109,642	20,296	14,019	12,579	2,014	335	148,885
Corn futures.....	63,949			6,008	1,367	367	71,691
Oats futures.....	73,440	13,154		177		761	87,332
Rye futures.....	26,269	1,874	3,636			134	31,913
Barley futures.....		1,561					1,561
Flax futures.....		798	3,155				3,953
Total.....	273,300	37,683	10,810	18,764	3,381	1,597	345,535
Nov. 29, 1924:							
Wheat futures.....	132,833	20,656	13,460	14,035	2,131	369	173,484
Corn futures.....	67,796			6,974	1,285	432	76,487
Oats futures.....	79,476	13,026		187		829	93,518
Rye futures.....	29,568	1,777	4,965			135	36,445
Barley futures.....		1,983					1,988
Flax futures.....		914	1,874				2,788
Total.....	309,673	38,361	10,299	21,196	3,416	1,765	384,710
Dec. 31, 1924:							
Wheat futures.....	115,784	20,416	13,598	10,908	2,220	428	153,324
Corn futures.....	70,409			6,425	1,472	351	78,657
Oats futures.....	97,630	14,112		369		1,058	113,169
Rye futures.....	22,991	1,503	5,139			46	29,679
Barley futures.....		1,340					1,340
Flax futures.....		607	1,357				1,964
Total.....	306,814	37,978	10,064	17,702	3,692	1,883	378,133
Jan. 31, 1925:							
Wheat futures.....	113,636	21,861	12,848	10,599	2,235	378	151,557
Corn futures.....	78,747			7,942	2,173	526	89,388
Oats futures.....	111,550	15,800		544		1,015	128,909
Rye futures.....	22,872	2,057	6,270			61	31,260
Barley futures.....		1,494					1,494
Flax futures.....		517	886				1,403
Total.....	326,805	41,729	10,004	19,085	4,408	1,980	404,011

¹ Durum and wheat added together.

TABLE 23.—*Grain futures: Customers' "open interest" (one side only), for six markets, by markets, by months, and by grains, with totals for all grains, at monthly intervals during the period July, 1924, to and including June, 1925—Con.*

[In thousands of bushels; i. e., 000 omitted]

Grain	Chicago	Minneapolis	Duluth	Kansas City	St. Louis	Milwaukee	Total
Feb. 28, 1925:							
Wheat futures.....	113,457	22,890	¹ 2,975	10,032	2,015	460	151,829
Corn futures.....	86,622	—	—	8,126	1,859	598	97,205
Oats futures.....	108,980	16,356	—	624	—	1,049	127,009
Rye futures.....	21,966	1,647	6,760	—	—	64	30,437
Barley futures.....	—	1,618	—	—	—	—	1,618
Flax futures.....	—	472	868	—	—	—	1,340
Total.....	331,025	42,983	10,603	18,782	3,874	2,171	409,438
Mar. 31, 1925:							
Wheat futures.....	97,591	19,089	¹ 2,966	7,227	1,144	203	128,220
Corn futures.....	76,323	—	—	8,859	1,474	464	87,120
Oats futures.....	78,415	17,370	—	511	—	848	97,144
Rye futures.....	17,739	1,496	6,883	—	—	99	26,217
Barley futures.....	—	1,460	—	—	—	—	1,460
Flax futures.....	—	363	734	—	—	—	1,097
Total.....	270,068	39,778	10,583	16,597	2,618	1,614	341,258
Apr. 30, 1925:							
Wheat futures.....	83,384	16,033	¹ 2,066	4,830	953	296	107,552
Corn futures.....	59,493	—	—	7,320	1,179	413	68,405
Oats futures.....	51,502	13,533	—	272	—	779	66,086
Rye futures.....	14,874	998	1,717	—	—	3	17,592
Barley futures.....	—	1,030	—	—	—	—	1,030
Flax futures.....	—	347	513	—	—	—	860
Total.....	209,253	31,941	4,286	12,422	2,132	1,491	261,525
May 29, 1925:							
Wheat futures.....	96,771	11,277	¹ 1,061	5,241	481	386	115,217
Corn futures.....	58,492	—	—	5,358	702	362	64,914
Oats futures.....	37,813	11,386	—	97	—	515	49,811
Rye futures.....	6,941	770	507	—	—	72	8,290
Barley futures.....	—	724	—	—	—	—	724
Flax futures.....	—	291	325	—	—	—	616
Total.....	200,017	24,448	1,893	10,696	1,183	1,335	239,572
June 30, 1925:							
Wheat futures.....	93,179	8,441	¹ 3,194	5,727	853	258	111,652
Corn futures.....	46,865	—	—	3,976	391	388	51,620
Oats, futures.....	37,807	11,781	—	112	—	523	50,223
Rye futures.....	8,840	642	672	—	—	84	10,238
Barley futures.....	—	489	—	—	—	—	489
Flax futures.....	—	277	523	—	—	—	800
Total.....	186,691	21,630	4,389	9,815	1,244	1,253	225,022

¹ Durum and wheat added together.

TABLE 24.—Wheat futures: Customers' "open interest" (one side only), all futures combined, for four principal markets, at weekly intervals, during the period July 1, 1924, to June 30, 1925

[In thousands of bushels; i. e., 000 omitted]

Week ended—		Chicago	Minneapolis	Duluth	Kansas City	Total
1924						
July	3	78,711	10,680	1,448	5,419	96,258
	12	84,942	10,238	1,494	5,982	102,656
	19	84,331	11,701	1,409	6,582	104,023
	26	91,738	9,263	1,662	6,997	109,660
Aug.	2	102,201	9,138	2,076	8,075	121,490
	9	108,285	9,697	2,184	9,555	129,721
	16	118,594	9,849	2,693	10,253	141,389
	23	121,191	10,922	3,658	10,701	146,472
	30	108,179	12,406	3,712	10,421	134,718
Sept.	6	106,612	12,304	4,346	10,727	133,989
	13	105,851	13,320	4,972	11,328	135,471
	20	107,860	13,586	5,128	11,126	137,700
	27	108,665	14,313	5,264	10,723	138,965
Oct.	4	104,649	16,551	4,724	13,078	139,002
	11	108,614	16,637	4,869	11,591	141,711
	18	114,507	18,045	4,739	11,679	148,970
	25	111,177	18,579	4,109	13,554	147,419
Nov.	1	109,371	20,195	3,955	12,671	146,192
	8	109,742	20,469	4,124	13,067	147,402
	15	118,314	19,748	3,943	14,330	156,335
	22	124,629	20,765	3,576	15,393	164,363
	29	132,833	20,656	3,460	14,035	170,984
Dec.	6	131,851	20,774	3,508	12,127	168,260
	13	124,372	20,180	3,935	11,498	159,985
	20	120,411	20,345	3,493	10,587	154,836
	27	117,355	20,080	3,536	10,106	151,077
1925						
Jan.	3	115,797	20,576	3,098	10,612	150,683
	10	123,993	21,331	3,584	10,557	159,465
	17	114,304	22,476	3,042	10,619	150,441
	24	115,908	22,315	2,961	10,440	151,624
	31	113,636	21,861	2,848	10,599	148,944
Feb.	7	111,788	22,623	2,857	9,527	146,795
	14	109,781	22,118	2,992	9,219	144,110
	21	112,554	23,173	2,969	9,341	148,037
	28	113,457	22,890	2,975	10,032	149,354
Mar.	7	120,934	23,333	3,141	9,298	156,706
	14	107,415	22,283	3,047	9,098	141,843
	21	107,973	20,437	2,910	7,610	138,930
	28	99,652	19,670	2,964	7,272	129,558
Apr.	4	97,071	17,890	3,084	6,589	124,634
	11	89,793	17,048	3,244	6,317	116,402
	18	92,796	17,088	3,102	5,191	118,177
	25	85,113	17,018	2,504	5,083	109,718
May	2	84,141	15,538	2,060	4,925	106,664
	9	83,328	14,361	1,595	5,180	104,464
	16	86,573	12,574	1,484	5,119	105,750
	23	90,471	11,737	1,298	5,336	108,842
	29	96,771	11,277	1,061	5,241	114,350
June	6	107,449	11,040	1,541	5,880	125,910
	13	108,648	10,441	2,184	6,559	127,832
	20	104,805	8,895	2,690	6,536	122,926
	27	97,219	8,736	2,887	6,387	115,229

¹ Durum and other wheat added together.

TABLE 25.—Grain futures: Customers' "open interest" in May wheat (one side only), for six markets, by markets, by months, at monthly intervals during the period July, 1924, to and including May, 1925

[In thousands of bushels; i. e., 000 omitted]

Date	Minneapolis	Duluth		Kansas City	St. Louis	Milwaukee	Total	Chicago	Grand total
		Durum	Spring						
1924									
July 31	188				35	22	245	10,225	10,470
Aug. 30	453	5		457	100	64	1,079	21,862	22,941
Sept. 30	2,226	170		2,217	254	123	4,990	32,754	37,744
Oct. 31	7,669	301		4,527	598	171	13,266	51,333	64,599
Nov. 29	17,387	2,172	183	9,912	1,748	284	31,686	98,336	130,022
Dec. 31	20,413	3,465	103	10,055	2,170	355	36,561	101,114	137,675
Jan. 31	20,861	2,741	102	8,789	2,124	260	34,877	83,857	118,734
Feb. 28	20,879	2,818	124	7,853	1,733	360	33,767	83,025	116,792
Mar. 31	15,399	2,651	207	5,076	688	105	24,076	57,963	82,039
Apr. 30	4,109	758	299	1,612	126	86	6,990	23,616	30,606
May 29								26	26

TABLE 26.—Wheat futures: Customers' "open interest" (one side only), by futures, Chicago Board of Trade, at weekly intervals during the period January 5, 1924, to June 27, 1925

[In thousands of bushels; i. e., 000 omitted]

Week ended—		July	September	December	May	Total
1924						
Jan.	5	21,014	596		75,712	97,322
	12	21,302	1,507		74,164	96,973
	19	21,433	2,203		73,162	96,798
	26	21,387	2,265		72,260	95,862
Feb.	2	23,195	4,331		69,572	97,098
	9	25,048	6,817		68,692	100,557
	16	25,806	9,402		69,481	104,689
	23	26,401	9,943		69,400	105,744
Mar.	1	27,125	10,188		69,214	106,527
	8	26,845	11,319		66,532	104,696
	15	27,164	12,675		64,811	104,650
	22	26,170	13,746		61,915	101,831
	29	26,097	14,790		51,856	92,743
Apr.	5	27,739	15,452	96	50,283	93,570
	12	28,628	15,868	106	49,017	93,619
	19	28,524	16,829	225	44,737	90,315
	26	33,111	17,538	321	36,563	87,533
May	3	38,767	18,220	541	7,496	65,024
	10	40,145	20,061	747	5,623	66,576
	17	39,472	19,464	1,260	3,836	64,032
	24	37,982	18,765	1,882	2,091	60,720
	31	40,278	21,913	2,897	40	65,128
June	7	35,064	23,752	4,006		62,822
	14	24,165	35,212	7,604		66,981
	21	18,562	44,860	12,147		75,569
	28	13,516	49,444	18,088		80,998
July	3	6,885	51,300	19,828	698	78,711
	12	5,793	53,490	24,021	1,638	84,942
	19	4,582	48,682	27,396	3,671	84,331
	26	3,958	52,306	29,943	5,531	91,738
Aug.	2		53,482	37,767	10,952	102,201
	9	95	51,122	43,427	13,641	108,285
	16	282	47,830	52,294	18,218	118,594
	23	751	40,382	57,765	22,293	121,191
	30	908	19,578	65,831	21,862	108,179
Sept.	6	963	7,970	73,591	24,088	106,612
	13	1,002	5,816	73,646	25,387	105,851
	20	1,475	5,133	72,706	28,548	107,860
	27	2,078	4,457	69,478	32,652	108,665
Oct.	4	3,272		65,588	35,789	104,649
	11	4,949		63,628	39,884	108,461
	18	6,110		64,392	43,852	114,354
	25	6,447		58,088	46,539	111,024
Nov.	1	6,491		51,018	51,862	109,371
	8	7,268		46,131	56,343	109,742
	15	8,084		38,016	72,214	118,314
	22	9,399		31,998	83,232	124,629
	29	10,549		23,948	98,336	132,833

TABLE 26.—*Wheat futures: Customers' "open interest" (one side only), by futures, Chicago Board of Trade, at weekly intervals during the period January 5, 1924, to June 27, 1925—Continued*

[In thousands of bushels; i. e., 000 omitted]

Week ended—		July	September	December	May	Total
1924						
Dec.	6	11,980	-----	13,009	106,862	131,851
	13	12,493	-----	7,143	104,736	124,372
	20	13,689	-----	4,273	102,414	120,376
	27	13,573	-----	1,753	101,994	117,320
1925						
Jan.	3	14,806	410	-----	100,581	115,797
	10	16,312	2,388	-----	105,293	123,993
	17	14,713	3,153	-----	96,438	114,304
	24	20,700	4,339	-----	90,869	115,908
	31	22,808	6,716	-----	83,857	113,381
Feb.	7	18,783	6,174	-----	86,831	111,788
	14	17,256	6,186	-----	86,339	109,781
	21	17,359	6,257	-----	88,938	112,554
	28	22,447	7,985	-----	83,025	113,457
Mar.	7	24,577	10,641	-----	85,716	120,934
	14	22,658	10,175	-----	74,582	107,415
	21	24,627	11,805	-----	71,541	107,973
	28	26,926	12,177	-----	60,549	99,652
Apr.	4	27,706	14,295	-----	55,070	97,071
	11	26,567	13,617	-----	49,609	89,793
	18	32,582	14,165	-----	46,049	92,796
	25	37,516	15,153	-----	32,444	85,113
May	2	48,517	15,660	477	19,487	84,141
	9	49,737	19,005	986	13,600	83,328
	16	52,491	22,909	1,522	9,651	86,573
	23	54,011	27,877	3,104	5,479	90,471
	29	53,126	33,598	9,991	26	96,741
June	6	47,912	41,986	17,526	-----	107,424
	13	42,300	46,025	20,318	-----	108,643
	20	35,049	48,737	20,969	-----	104,755
	27	26,298	47,443	23,473	-----	97,214

REPORT OF THE FEDERAL HORTICULTURAL BOARD

UNITED STATES DEPARTMENT OF AGRICULTURE,
FEDERAL HORTICULTURAL BOARD,
Washington, D. C., October 1, 1925.

SIR: I submit herewith an executive report covering the administration of the plant quarantine act for the fiscal year ended June 30, 1925.

Respectfully,

C. L. MARLATT,
Chairman.

Hon. W. M. JARDINE,
Secretary of Agriculture.

INTRODUCTION

During the period under review two members of the board, namely, W. A. Orton, vice chairman, and K. F. Kellerman, both of the Bureau of Plant Industry, resigned. The former was appointed vice chairman of the board in 1912 and served continuously in that capacity until the date of his resignation from the department November 10, 1924, to assume the directorship of the Tropical Plant Research Foundation. Doctor Kellerman, who succeeded A. V. Stubenrauch as a member of the board in July, 1914, was forced to sever his membership with the board December 24, 1924, on account of the increased demands of his duties as associate chief of the Bureau of Plant Industry. These members were succeeded respectively by R. A. Oakley, vice chairman, and M. B. Waite, both of the Bureau of Plant Industry.

All of the quarantines and regulations thereunder, together with administrative and interpretative orders and formal public notices with respect to such quarantines and regulations, are given permanent record in the Service and Regulatory Announcements published quarterly. This annual report has, therefore, been limited to a little more than a summary of these activities. As in the past, however,

it reports and gives permanent record to the statistical tables indicating the importations of the various plants and plant products the entry of which is restricted and safeguarded under various foreign plant quarantines. These tables, from year to year, give a continuing and detailed record of entry of such restricted products not available elsewhere. (See pp. 9-22).

Aside from certain minor amendments to a few of the existing foreign and domestic quarantines (see p. 23), the only new quarantine action taken during the year was the promulgation May 27, 1925, of the fruit and vegetable quarantine applying to Porto Rico, effective July 1, 1925. The purpose of this quarantine is to prevent the entry into the mainland of the United States of certain injurious fruit and vegetable insects known to occur in Porto Rico. Fortunately these enemies do not concern the important exports to the United States from that island.

The very important port inspection service of the board is discussed in some detail in pages 8 and 9. The extent of the field and the volume of products which are thus controlled and safeguarded is indicated in the tables given in that part of the report.

Another and distinctive field of activity of the board is its connection with the control and eradication

work with respect to such introduced pests as the pink bollworm, the European corn borer, Japanese beetle, gipsy moth, and date scales, and such introduced plant diseases as the white pine blister rust and the black stem rust of small grains. This work has been carried out either by the board directly, as in the case of the pink bollworm and the date scales, or in cooperation either with the Bureau of Entomology or the Bureau of Plant Industry of the department. The restrictions and safeguards on any necessary movement of products to prevent spread of the pest concerned are enforced under specific quarantines. A brief review of these activities for the fiscal year follows.

THE PINK BOLLWORM—STATUS OF THE ERADICATION EFFORT

The control of the pink bollworm of cotton is, on the whole, in a very satisfactory status. No new areas of infestation have developed and this pest is still confined, so far as known, to certain areas in western Texas and New Mexico, which, on account of proximity to, or contact with, infested areas in Mexico, must continue to be subject to reinfestation by this pest at least until Mexico can be induced to cooperate in some project for its control.

The success which has attended the eradication efforts in eastern Texas and Louisiana has been noteworthy when consideration is given to the wide extent of territory originally infested and the difficulties which have often attended the securing of proper State legislative support and occasionally of cooperation, although as a rule the cooperation of growers and State officials has been good. It is encouraging also, as indicating that any new areas of infestation which may develop at any time from possible reinfestation from Mexico or other means, may be eradicated by like control methods.

Table 1 gives the time that has elapsed since the last infestation was located for each of such eastern areas, and indicates such considerable periods of years as to greatly strengthen the belief that this effort has been completely successful. The term "man-day" as used in this and other tables means a full day's inspection of cotton fields by a trained inspector.

TABLE 1.—*Time elapsed and man-days of scouting since last infestation, all eastern districts*

District	Man-days	Time	
		Years	Months
Hearne, Tex.....	2,430	7	9
Trinity Bay, Tex.....	4,011	3	9
Ennis, Tex.....	2,358	3	6
Marilee, Tex.....	2,076	3	6
Cameron, La.....	2,544	5	4
Shreveport, La.....	2,047	4	6

In western Texas and New Mexico there has been no material change in the situation, and in these areas, for the reasons given above and more fully detailed in previous annual reports, no attempt is being made to eradicate the pest. The effort here is to reduce the amount of infestation in the fields and prevent the carriage of infested material to other parts of the country through the movement of cotton lint and seed. This effort has been aided by the isolation of the western districts from the main Cotton Belt, but unfortunately this isolation is being constantly reduced by the westward extension of cotton culture. Table 2 gives a record of these western districts for the crop years 1918 to 1924, indicating for each year the acreage, the number of infested fields, and the number of man-days devoted to field inspection. The considerable variation in the amount of infestation from year to year indicated in this table is due in part to the clean-up measures which have been taken and to disinfection of cottonseed at gins, but also in part, and perhaps largely, to the climatic control which obtains in these western areas where, on account of elevation, there is always likelihood of early frosts and low winter temperatures, resulting in the very material control of this pest. In the Big Bend district, on the other hand, there has been a steady and rather rapid increase of infestation, and even in the other districts it is reasonable to anticipate that there may be considerable fluctuation in the amounts of infestation from year to year, due to variation in climate. It is apparent, therefore, that the western areas constitute a source of infestation which may carry this pest to other parts of the country at any time, and hence one of the greatest dangers in the entire pink bollworm problem is this possibility of spread from domestic sources.

Western districts showing number of acres, man-days of scouting, and number of infested fields 1918 to June 30, 1925

District	1918			1919			1920			1921		
	Number acres	Man-days	In-fested fields	Number acres	Man-days	In-fested fields	Number acres	Man-days	In-fested fields	Number acres	Man-days	In-fested fields
Big Bend, Tex.....	508	4	21	100	T.	1	(1)	0	0	392	22	12
Pecos Valley, Tex.....	15,000	555	9	24,000	1,123	1	30,000	850	15	21,407	299	21
El Paso Valley, Tex.....	300	103	0	1,800	158	0	15,000	339	14	5,991	78	9
Mesilla Valley, N. Mex.....	(2)	0	0	(2)	0	0	4,500	240	5	358	27	6
Carlsbad, N. Mex.....	6,500	111	0	10,000	57	0	17,000	310	2	12,348	40	4
Eastern counties, New Mexico.....	(2)	0	0	(2)	0	0	(2)	0	0	(2)	23	0
Total.....	22,308	773	30	35,900	1,338	2	66,500	1,739	36	40,496	489	52

District	1922			1923			1924		
	Number acres	Man-days	In-fested fields	Number acres	Man-days	In-fested fields	Number acres	Man-days	In-fested fields
Big Bend, Tex.....	864	27	24	(2)	66	36	6,500	167	62
Pecos Valley, Tex.....	20,000	386	0	21,080	421	5	32,841	631	15
El Paso Valley, Tex.....	17,000	261	4	25,000	406	1	37,673	397	1
Mesilla Valley, N. Mex.....	3,500	77	1	13,000	231	0	35,879	260	0
Carlsbad, N. Mex.....	19,000	236	0	38,000	561	0	50,000	441	0
Eastern counties, New Mexico.....	4,000	46	0	40,000	651	0	62,500	186	0
Total.....	64,364	1,033	29	137,080	2,336	42	225,393	2,082	78

¹ Noncotton zone.

² Figures not available.

T. Trace.

Another hazard exists along the Rio Grande from Del Rio to Brownsville. The recent development of cotton culture in Texas has resulted in greatly increased acreages of cotton along the Rio Grande. Correspondingly, there has also been considerable increase in the acreage nearby in Mexico. No infestation has been found in the lower Rio Grande Valley either in Mexico or in the United States, but there is the continual risk of such infestation from the interior of Mexico. As indicated under "Mexican border control," the pink bollworm is constantly being found in freight cars arriving at the border ports. Should the pink bollworm become established in the lower Rio Grande Valley in Mexico it would inevitably result in the very early infestation of the fields in Texas along the border and greatly increase the work of control, and even render doubtful the prevention of the spread of this pest widely in Texas and into other cotton-growing States. To reduce this danger, the cooperation has been secured of the local government officials in Mexico and of the local commercial interests and planters. An effort is also being made to induce the central Government of Mexico to

undertake measures similar to those which we are enforcing at the border ports of the United States, to protect the important cotton development in these border States in Mexico from invasion from the Laguna and perhaps other points in the interior of Mexico, where the pink bollworm is thoroughly established.

COTTONSEED DISINFECTION

For the purpose of determining their efficiency, considerable time was devoted to the investigation of cottonseed disinfecting machines, which have been installed under State regulations in all gins in the districts in which any recent infestation has been found. At present there are several types of heating machines in use and numerous innovations have been made by local ginners. These investigations have revealed a wide range in the efficiency of such apparatus, from practically nothing to a maximum of 75 to 80 per cent. The unreliability of this method and the imminent risk which would accompany seed so treated if it were distributed to noninfested areas is clearly indicated by this investigation. A technical study of the various types

of heating machines in operation has been undertaken with the object of developing a fully efficient type suitable to the conditions obtaining at gins.

PINK BOLLWORM RESEARCH WORK

The technical studies of the pink bollworm which have been carried out in the Laguna district of Mexico for a considerable series of years have been largely discontinued. It is, however, deemed very necessary and useful to keep more or less observation of this and other districts in Mexico invaded by the pink bollworm, to determine any new phases of the situation which may develop and, incidentally, the variation in infestation from year to year and the benefits of any control measures which may be undertaken there based on the studies which have been made in previous years and which are being to some extent adopted by growers. It is proposed to undertake, however, a supplemental series of investigations in the Big Bend district in Texas, where the pink bollworm has become so thoroughly established as to make such studies desirable and possible. Among other subjects, this work will deal with the conditions under which local variations in the abundance of the insect occur, the testing of certain poisons suggested by the preliminary work in Mexico, and methods of fumigating cotton lint and seed.

ROAD INSPECTION

The rapid increase in automobile traffic involves the danger of distributing infested material from the western infested districts. This danger is being minimized as much as possible by the establishment of some six inspection stations on the principal roads radiating from these areas. At these stations 48,172 automobiles were inspected during the year, resulting in the interception of 1,949 lots of cotton material, along with 2,227 lots of contraband fruits, vegetables, etc., which might convey pests other than the pink bollworm.

CONFERENCE AT EL PASO

On April 10, 1925, the board held a conference in El Paso to consider various problems which had arisen with respect to the control work in the western areas. This conference was attended by officials of Texas and New Mexico and some four other States, and many persons interested in cotton production. It was the judgment of this conference that the

control measures as to these western areas should be strengthened by requiring, under Federal and State authority, the crushing of all seed produced within these districts and the vacuum fumigation of all lint. This action was heartily indorsed somewhat later at New Orleans at a meeting of the quarantine officials and entomologists of most of the Southern States. A vacuum fumigation plant had already been erected at El Paso and additional plants were later authorized by the board and are now in process of erection at Pecos and Marfa, in Texas, and at Las Cruces in New Mexico, for the handling of the crop of 1925 and later crops. In connection with the crop of 1924 the El Paso plant fumigated 11,965 bales of cotton, of which 3,611 were imported from the immediately adjacent portions of Mexico. Cotton so fumigated is freed from further restrictions and may move to any point in the United States on the same basis as cotton entered under disinfection at the ports of New York, Boston, etc.

RELEASE OF QUARANTINED AREAS

The long period of apparent freedom from any recurrence of pink bollworm in the infested areas in Louisiana (see p. 2) has been made the basis of releasing these areas from further restrictions on account of the pink bollworm. These districts, however, will be kept under observation and careful scouting for such further period as may seem to be justified.

Similarly, certain counties in eastern New Mexico have been released from further restriction. These counties originally were brought under quarantine on account of the fact that quantities of cottonseed for planting had been carried into them from Carlsbad just prior to the determination in 1920 of the infestation in the Carlsbad district. Inasmuch as no infestation has been found in these counties now released for a three-year period, the elimination of the restrictions seems to be fully justified. The Carlsbad territory is, however, still under the restrictions on the movement of cotton products.

PINK BOLLWORM SCOUTING

The success of the effort to keep the pink bollworm out of central and eastern Texas and Louisiana and, in general, the Cotton Belt of the United States, is conditioned on the prompt discovery of any new outbreaks from old infestations or any new points of

infestation. This involves the annual scouting of the danger points in Texas, Louisiana, and New Mexico, and other points in the Cotton Belt which, for any reason, may be open to suspicion. The insurance value of this work would seem to fully justify its continuance, especially in view of the constant risk of carriage of the pest from Mexico and also, but to a much less extent, because more fully controlled, from the areas of infestation in western Texas and New Mexico. During the season 1924-25 this work involved some 6,026 man-days of inspection, the distribution of which as to districts so far as it applies to the areas in Texas, Louisiana, and New Mexico which have at any time been invaded by this pest, is indicated in Table 3.

TABLE 3.—*Man-days scouting in all districts, 1923 and 1924 and number of infested fields*

District	1923		1924	
	Man-days	In-fested fields	Man-days	In-fested fields
Texas:				
Hearne.....	255	0	0	0
Trinity Bay.....	1,225	0	1,030	0
Big Bend (west Texas).....	66	36	167	62
Pecos Valley.....	421	5	631	15
El Paso Valley.....	406	1	397	1
Ennis.....	740	0	835	0
Marlee.....	611	0	612	0
Louisiana:				
Cameron.....	718	0	655	0
Shreveport.....	648	0	744	0
New Mexico:				
Mesilla Valley.....	231	0	260	0
Carlsbad.....	1,212	0	695	0
State totals:				
Texas.....	3,724	42	3,672	78
Louisiana.....	1,366	0	1,399	0
New Mexico.....	1,443	0	955	0
Grand total....	6,533	42	6,026	78

MEXICAN BORDER CONTROL

The Mexican border control service has for its principal purpose the prevention of the further entry of the pink bollworm from Mexico into the United States, more particularly with respect to any movement—accidental or otherwise—of cotton or cottonseed either in uncleaned freight cars or in connection with shipments of products of any kind. In connection with this service, there have been enforced the various fruit and vegetable quarantines in so far as they apply to products arriving from Mexico. The board's inspectors

also cooperate with the Customs Service in the footbridge and line inspection of baggage and personal effects, and with the Post Office Department in the examination of parcel post packages arriving from Mexico. In connection with the footbridge and line inspection, several thousand items of contraband plants and plant products have been intercepted.

For the handling of the rail traffic five fumigation houses, which will accommodate from 4 to 20 freight cars each, are in operation at the more important ports of entry. At Del Rio, where there are no railroad connections with the interior of Mexico, a small house is used to disinfect wagons and trucks fouled with cottonseed. During the year 34,545 freight cars were inspected, and of this number 18,575 were fumigated, for which fees amounting to \$54,128 were collected and turned into the Treasury as miscellaneous receipts. Of the cars found to be fouled with cottonseed, 57 contained seed in which living pink bollworms were present. At Del Rio 21,158 wagons, trucks, etc., were inspected and 30 fumigated.

The experiments with the use of liquid hydrocyanic acid gas for such disinfection were continued from last year and the results having indicated that this liquid gas can be effectively and economically employed, its use has therefore been authorized. This will obviate the necessity for the further employment of expensive generators which are short lived and also considerable freight charges incident to the shipment of cyanide and sulphuric acid to the various border ports.

Owing to the volume of traffic at Douglas, Ariz., an inspector was stationed at that port beginning with March. He also cooperates with the customs officials at Naco, Ariz., in the enforcement at that port of the plant quarantine restrictions.

EUROPEAN CORN BORER, JAPANESE BEETLE, AND GIPSY MOTH

The domestic quarantines on account of the European corn borer, the Japanese beetle, and the gipsy moth are being enforced by this board in cooperation with the Bureau of Entomology of the United States Department of Agriculture. The principal object of these quarantines in connection with each of these pests is to prevent long-distance spread through the commercial or other movement of farm and forest products in which the insects breed or on or in which they may be carried, and the efforts of the board

and bureau in this direction during the year have apparently been successful. The first two of these quarantines have been revised during the year to incorporate the additional territory determined as infested. All such extensions, however, have been in connection with old centers of infestation and represent a natural and in large part unpreventable spread of these pests. The spread of the gipsy moth has been prevented by the maintenance of the barrier zone established in 1924, extending from Lake Champlain southward along the valley of the Hudson. Inasmuch as the detailed administration of these quarantines is being conducted in cooperation with the board, under special appropriations assigned to the Bureau of Entomology, reference is made for a complete statement of the work to the report of that bureau.

DATE-SCALE ERADICATION

The effort to eradicate the Parlatoria date scale has been continued and the results obtained are encouraging. Some considerable new outbreaks were discovered in the eastern end of Coachella Valley early in 1925 and an active eradication campaign has since been in progress and the infestations have been greatly reduced. It now appears that this pest has been eradicated from nine-tenths of the date orchards, but it is highly important that the lingering infestations be completely wiped out. Illustrating this need, it is significant to note that one of the large date oases in western Algeria has during recent years become infested with this pest for the first time. As the result of the infestation, the date palms in this oasis have practically ceased to produce marketable fruit and the attention of the French Government and local authorities has been directed thereto in an attempt to combat the pest.

Other date pests have also been given attention and methods have been developed, in cooperation with the Bureau of Entomology, which apparently now make possible the securing of pest-free offshoots of all important varieties. These, if planted in isolated valleys, will give rise to clean offshoots which can be shipped without the risk of distributing the date scales.

It also appears that consideration is now being given to the development of date production in Australia, South Africa, and South America, and it is very probable that if pest-free offshoots are available in the United States there would be a ready sale for them in these countries instead of making the effort to

obtain them from the Old World with practical certainty of infestation by these scales.

WHITE PINE BLISTER RUST AND BLACK STEM RUST

The domestic quarantines on account of the white pine blister rust are being enforced by this board in cooperation with the Bureau of Plant Industry of the United States Department of Agriculture. The principal object of these quarantines is to prevent long-distance spread through the commercial or other movement of pines and other host plants infected by this disease. The control of the black stem rust of small grains is based on the elimination of its alternate host plant, the common barberry, and the quarantine powers invoked are to prevent the reintroduction and planting of this bush in the States where protection is necessary and is being extended. Inasmuch as the detailed administration of these quarantines is being conducted in cooperation with the board, under special appropriations assigned to the Bureau of Plant Industry, reference is made for a complete statement of the work to the report of that bureau.

FRUIT-FLY SURVEYS IN CUBA, SPAIN, PORTUGAL, ITALY, ARGENTINA, CHILE, AND PERU

The fruit-fly surveys in Cuba which were begun during the fiscal year 1924 were continued, and as the result of the evidence accumulated to the effect that the West Indian fruit fly does not attack avocados and citrus fruit in that Republic and that these fruits are apparently free from attack by other injurious insects new to the United States, permits were issued under Quarantine 56 authorizing the entry of the former at southern as well as northern ports. In the case of citrus fruit, provision was made for its entry in sealed refrigerator cars for immediate transportation in bond for customs entry at St. Louis, Chicago, and Cincinnati, at which ports the fruit is examined by representatives of the board. This arrangement supplements the former provision which limited the entry of these fruits to New York and other northern Atlantic ports.

The infestation of the so-called Malaga grape arriving at American ports of entry in the latter part of 1923 and the quarantine action which was taken with respect thereto is discussed on pages 10 and 11 of the annual report for 1924. Early in July, 1924, the department

was informed that steps had been taken to eradicate the Mediterranean fruit fly from the Province of Almeria, and at the earnest request of the Spanish authorities a fruit-fly specialist was sent to Spain to determine whether or not these efforts had been successful. As the result of this investigation in the Province of Almeria, which extended through the entire month of August, 1924, it was determined that the Mediterranean fruit fly was established in the following nine principal fruit districts of the Province: Canjajar, Alhama, Rioja, Pechina, Viator, Almeria, Agua Dulce, Dalias, and Berja. The fruits infested included oranges, peaches, apricots, pears, and figs. The fly is carried through the summer on these fruits in a series of generations, attacking the fig in August, September, and October. The universality of the fig, in every dooryard, along roadways, and in occasional orchards, makes this fruit the principal source of the flies which infest the grape as the latter ripens from the middle of September to the middle of October. The enormous number of flies at the end of the season, multiplied many times with each successive brood in the fig, leads to the infestation of the grape, which begins to ripen as the fig crop ends and which normally is not a favorite host of the fly.

The determination of the general establishment of this pest throughout the Province made it evident that the risk from the Spanish grapes would certainly continue with respect to the crop of 1924, and notification was duly issued that these conditions made it impossible to modify the embargo.

Opportunity to definitely confirm the infestation of the crop of 1924 was afforded by the arrival of a shipment of these grapes at New York for transshipment to the Dominican Republic. The routine inspection of this shipment for landing as a condition of export developed the fact that it was so infested. As a result of this finding the Dominican authorities refused to authorize the transshipment of these grapes. Similar shipments which went direct to Cuba were also found to be infested on examinations authorized by the Cuban authorities at Habana, and were excluded on the basis of a decree prohibiting entry of these grapes which had been earlier promulgated. Both Santo Domingo and Cuba have taken formal action prohibiting the entry of these grapes, realizing not only that the menace of the fruit fly was if anything more important to them than to the United States, on

account of their climatic and fruit conditions, which presented the maximum of opportunity for the pest, but also because the interests of these and other West Indian islands are closely tied up with those of the United States as the principal market for their fruits and vegetables. Shipments of grapes made direct to Canada were reported by the Canadian authorities to be infested. It is distinctly understood that all of this infestation was trivial from the standpoint of any damage to the fruit, but nevertheless fully confirmed the danger with respect to these grapes to the United States, a danger which the poisoning and other control operations instituted in the Almeria district of Spain had evidently not eliminated.

The investigations in Spain were supplemented by rather hurried investigations of fruit districts of Portugal and Italy, with respect to the Mediterranean fruit fly and other pests, to secure information necessary in determining import restrictions on the fruits and vegetables of these countries, in both of which the Mediterranean fruit fly is established, as it is also in the Riviera of France.

Similar surveys were made from January to March of the fruit districts of Argentina. These surveys were necessitated by the fact that Argentina was developing a considerable fruit export to the United States and there were records which seemed to be authentic of the occurrence of the Mediterranean fruit fly at least in portions of that country. No evidence was found of the occurrence of the Mediterranean fruit fly in any portion of Argentina, and it seems probable that the older records referred to are based on a confusion of this fruit fly with a related species—the West Indian fruit fly—a pest which is fully established at least in the Tucuman region of Argentina. Fruit from this region is, however, not exported to the United States. The detailed information obtained from this survey will be of service in placing necessary safeguards on the entry of Argentine fruit. On the return, very brief surveys were made of the fruit situation from the pest standpoint in Chile and Peru, without, however, developing any evidence of the presence of the Mediterranean fly. The work was so limited, however, as to be inconclusive. With respect to Chile there is every reason to believe that the Mediterranean fruit fly is not present. Not only has Chile a good inspection service, but protection is being obtained by adequate quarantine measures.

PLANT QUARANTINE INSPECTION

The plant quarantine inspection service is charged with the enforcement at the maritime and interior ports of entry (including Washington) of all foreign and a number of the domestic quarantines promulgated under the plant quarantine act of 1912. This work is performed in close cooperation with the Customs Service and the Post Office Department, and involves the inspection of all plants and plant products (including fruits and vegetables) restricted as to entry, and, when necessary, their fumigation or sterilization; the inspection and disposition of plants and plant products found in passengers' baggage by officials of the Customs Service; the inspection of ships' stores and crews' quarters for contraband plants, fruits, vegetables, etc., and the examination of restricted plants and plant products arriving in foreign parcel-post mail. In addition, all plants, seeds, etc., introduced by the Department of Agriculture are examined upon arrival, in the especially equipped inspection house in Washington, D. C., and again prior to distribution from the introduction gardens of the Bureau of Plant Industry. This service also enforces the Rules and Regulations Governing the Movement of Plants and Plant Products into and out of the District of Columbia.

MARITIME PORT INSPECTION

Inspectors have been provided for the more important ports of entry, but owing to the limited funds available for this purpose, certain of the ports are at present undermanned, resulting in much overtime work, for which the inspectors do not receive additional compensation. Considerable expansion of this service has been made during the year, particularly as applied to New York City. Representatives of the board are now stationed at Astoria, Ore.; Baltimore, Md.; Boston, Mass.; Charleston, S. C.; Galveston, Tex.; Mobile, Ala.; New Orleans, La.; New York City; Philadelphia, Pa.; Portland, Ore.; Seattle, Wash.; St. Louis, Mo.; and San Juan, Porto Rico. Through the cooperation of State plant-quarantine officials, protection is also afforded at the following ports: Eureka, Gaviota, San Luis Obispo, San Francisco, San Pedro, and San Diego, Calif.; Gulfport and Pascagoula, Miss.;

Pensacola, Tampa, Key West, Miami, and Jacksonville, Fla.; Savannah, Ga.; Cincinnati, Ohio, and Honolulu, Hawaii. In collaboration with the United States Customs Service, inspection is also conducted at Newport News and Norfolk, Va., and Portland, Me. With respect to the examination of plants introduced under regulation 3 of the "Rules and Regulations Supplemental to Notice of Quarantine No. 37," this service is materially aided by the several State entomologists and their assistants.

Exclusive of California, Mississippi, and Florida ports, where the inspection is performed by State officials, serving as collaborators of the department, representatives of the board have boarded and examined during the period under review 13,310 foreign vessels, 6,780 of which were found to carry contraband plants or plant products. The plants and fruits and vegetables, as well as other plant products listed elsewhere in this report were examined at the ports of entry, and in the case of cotton and broomcorn, fumigated and sterilized respectively as a condition of entry.

As in the past, representatives of the board have made inspections of the various plant introduction gardens maintained by the Department of Agriculture at Miami and Brooksville, Fla.; Savannah, Ga.; Chico, Calif.; and Mandan, N. Dak.

PESTS INTERCEPTED

During the fiscal year the inspectors and collaborators of this service collected on or in imported plants and plant products 516 recognized species and 373 insects which could be placed generically only. The Mediterranean fruit fly was intercepted on a number of occasions from the Azores, Hawaii, Spain, and Syria, infesting loquats, avocados, coffee berries, mangoes, oranges, papayas, peppers, string beans, olives, sour oranges, tangerines, grapes, and quinces. The West Indian fruit fly, another injurious fruit insect was collected in guavas from Cuba and Mexico and mangoes from Jamaica and Porto Rico. The Mexican fruit fly was intercepted in the following fruits from Mexico: Grapefruit, mamey, mangoes, oranges, peaches, pears, quinces, sapotes, and sweet limes. Beans and cucumbers from Hawaii were found to be infested with the melon fly, and the serpentine fruit fly was taken in cherimoya from Mexico.

As in previous years, fruit stocks from France, upon inspection, were found to be infested with the following insects: Brown tail, gipsy, dagger, and European tussock moths; sorrel cut worm; white tree pierid. The wireworms *Athous haemorrhoidalis* and *A. niger* were found in French lily and Dutch narcissus bulbs, respectively. The narcissus fly was taken in hyacinths and narcissus bulbs from Holland and the lesser bulb fly was intercepted in hyacinth bulbs from Holland, narcissus bulbs from France, Holland, and the island of Guernsey, and in onions from Greece. The European earwig was found in cases of hyacinths and narcissi from Holland.

The turnip gall-weevil (*Ceutorhynchus pleurostigma*) was intercepted in turnips from Denmark, England, France, Germany, and Holland. As in former years, the pink bollworm was repeatedly collected, having arrived with material from China, Egypt, Mexico, Paraguay, St. Lucia, and France. Avocados from Mexico were infested with the avocado weevil and with two other species of weevils, namely, *Conotrachelus aguacate* and *C. perseae*, which do not occur in this country. Mangoes from Hawaii and Egypt were found to be infested with the mango weevil, and the citrus black fly was repeatedly taken on various hosts arriving from Cuba and Jamaica. Sweet potatoes from Argentina, Brazil, Hawaii, Porto Rico, and Turk's Island, and yams from Barbados, Haiti, and Tahiti were found to be infested with the West Indian sweet potato weevil, *Euscepes batatae*. This list includes only a few of what appear to be the more important pests, a complete list of which will be published in the Service and Regulatory Announcements.

RECORDS OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS

Under various foreign quarantines certain plants and plant products are restricted as to entry and made subject to inspection, and if necessary, disinfection, for the purpose of excluding various plant diseases and insect pests. Among these restricted plants and plant products are nursery stock, plants, and seeds for propagation, fruits and vegetables, grains from certain countries, broomcorn, and cotton, cotton waste, cotton wrappings, and cottonseed products.

The records of the importations of these articles are indicated in the following discussion and tables.

IMPORTATIONS OF NURSERY STOCK, PLANTS, AND SEEDS¹

The importations recorded in Tables 4, 5, 6, and 7 are entered under regulation 3 of Quarantine 37, under permits which are made continuing and unlimited as to the quantity which may be imported. The restrictions under this regulation are intended merely to afford opportunity to inspect, and, if necessary, safeguard the products as they are so entered. In the case of Table 4, the entries made in the preceding year are also listed for the purpose of comparison, and in Table 6 the bulb entries of the last six years are brought together to show the fluctuation in the entry of different classes of bulbs.

¹ Except as restricted by specific quarantines, field, vegetable, and flower seeds, and plant products imported solely for medicinal, food, or manufacturing purposes, are not restricted as to entry, and the taking out of permits for such articles is not required. No record is therefore kept by the Federal Horticultural Board of the entry of such articles.

TABLE 4.—Importation of fruit, rose, and nut stocks, cuttings, and scions, under quarantine No. 37 during fiscal year ended June 30, 1925¹

[Figures indicate number of plants]

Kind of stocks, cuttings, and scions	Belgium	Canada	England	France	Germany	Greece	Holland	Hungary	Ireland
Apple.....		196		5,238,650			21,000		
Cherry.....			130	8,168,525			97,000		
Grape.....				223		600		300	
Olive (cuttings).....				405					
Pear.....				3,215,635			61,000		
Plum.....			39	2,179,275			2,000		
Quince.....				933,150			18,500		
Rose.....	12,000		2,705,500	1,870,300	2,000		3,643,524		45,200
Nut.....				34,786					
Total.....	12,000	196	2,705,669	21,640,949	2,000	600	3,843,024	300	45,200

¹In addition to the consumption entries reported in this table, 276,050 fruit and rose stocks were entered for immediate exportation to other countries.

TABLE 4.—*Importation of fruit, rose, and nut stocks, cuttings, and scions, under quarantine No. 37 during fiscal year ended June 30, 1925—Continued.*

Kind of stocks, cuttings, and scions	Italy	Malta	Mexico	Palestine	Portugal	Scotland	Spain	Syria	Total	
									1924-25	1923-24
Apple.....	348,800								5,608,646	4,605,869
Cherry.....	240,000					27,000			8,532,655	11,348,150
Fig (cuttings).....	180	20							200	
Grape.....	600		1,000	144	15		8	15	2,905	1,988
Olive (cuttings).....									405	50
Pear.....	45,000								3,321,635	3,745,540
Plum.....	90,000								2,271,314	3,351,350
Quince.....	12,000								963,650	1,043,500
Rose.....						20,000			8,298,524	10,126,433
Nut.....									34,786	24,950
Total.....	736,580	20	1,000	144	15	47,000	8	15	29,034,720	34,247,830

TABLE 5.—*Importation of bulbs under regulation 3 of quarantine 37, during fiscal year ended June 30, 1925¹*

[Figures indicate number of bulbs]

Bulbs	Azores	Belgium	Bermuda	Canada	China	Czechoslovakia	Denmark	England	France	Germany
Chionodoxa.....								923		
Crocus.....	30						20	4,942	4	17
Eranthis.....								610		
Fritillaria.....								274		
Galanthus.....				79		18	50	1,548		117
Hyacinths.....				51			24	314	906,522	48
Ixia.....								150		
Lily.....	21,578	16	678,412	14	221			13,912	323,832	5,849
Lily of the valley.....								90	385	17,935,211
Muscari.....								1,635	2	
Narcissus.....			100,800	95	1,374,900		4	994,953	63,153,406	12
Scilla.....								3,188		5
Tulips.....		5,200		398			199	1,353	118,550	138
Total.....	21,608	5,216	779,212	637	1,375,121	18	297	1,023,892	64,502,701	17,941,397

Bulbs	Holland	India	Ireland	Italy	Japan	Scotland	Sweden	Wales	Total
Chionodoxa.....	464,499								465,422
Crocus.....	10,619,501						6	150	10,624,670
Eranthis.....	152,177								152,787
Fritillaria.....	104,057							152	104,483
Galanthus.....	893,141					50			895,003
Hyacinths.....	27,040,271			25		6			27,947,261
Ixia.....	371,833								371,983
Lily.....	152,942	9	22	7,815	10,002,932	2		3	11,207,559
Lily of the valley.....	1,044,625								18,980,311
Muscari.....	904,622								906,259
Narcissus.....	40,689,570		35	26			48	200	106,314,049
Scilla.....	1,739,101			220					1,742,514
Tulips.....	96,163,628						20	966	96,290,452
Total.....	180,339,967	9	57	8,086	10,002,932	58	74	1,471	276,002,753

¹In addition to the consumption entries reported in this table, 581,392 bulbs were entered for immediate exportation to other countries.

TABLE 6.—Summary of bulb importations, 1919-20 to 1924-25

Bulbs	1919-20	1920-21	1921-22	1922-23	1923-24	1924-25
Chionodoxa ¹					339,766	465,422
Crocus	3,977,892	5,514,805	6,319,082	8,286,500	10,815,920	10,624,670
Eranthis ¹					93,314	152,787
Fritillaria ¹					92,951	104,483
Galanthus ¹					797,381	895,003
Hyacinths	16,375,494	22,568,891	24,808,236	29,142,797	32,197,740	27,947,261
Ixia ¹					335,158	371,983
Lily	14,538,936	22,490,533	8,219,460	9,145,630	9,690,486	11,207,559
Lily of the Valley	9,964,847	3,608,746	14,951,170	19,603,092	17,568,835	18,980,311
Muscari ¹					612,329	906,259
Narcissus	56,032,918	77,956,195	77,270,548	77,193,281	92,659,666	106,314,049
Scilla ¹					994,762	1,742,514
Tulips	49,972,184	55,075,343	64,846,940	76,719,116	92,539,157	96,290,452
Unclassified	1,653,790	4,756,369	70,750	183,900		
Total	152,516,061	191,968,882	196,486,186	220,274,316	258,737,465	276,002,753

¹ Imported under special permit from June 1, 1919, to Jan. 1, 1923.

TABLE 7.—Importation of tree seeds under quarantine No. 37 during fiscal year ended June 30, 1925 ¹

[Figures indicate number of pounds]

Country of origin	Apple	Avocado	Cherry	Nut and palm	Ornamental and tree	Pear	Per-simon	Plum	Quince	Raspberry	Rose	Strawberry	Total
Australia				1,911	140								2,051
Austria	100		66	27,121	65			113	26		5		27,496
Brazil				1,480									1,480
Canada				25	1,216								1,241
Chile					288								288
China					1,859	110		1,000					2,969
Cuba		63,613		952	286								64,565
Czechoslovakia											11		297
Dominican Republic				104									104
France	15,073		5,225	25	4,740	2,105	25	765	60	3	3	5	28,029
Germany					607								607
Holland					595								595
Honduras				375									375
Italy					1,428			237					1,665
Japan			76	87	2,423	2,007	102	130	153		222		5,200
Manchuria						13							13
Persia									2,848				2,848
Scotland					15								15
Sweden					400								400
Trinidad, British West Indies				731									731
Total	15,173	63,613	5,367	5,690	41,118	4,300	127	2,245	3,087	3	241		5140,969
1923-1924	25,473		7,539	28,958	27,053	2,391	822	10,657	71		1,306		104,270

¹ 671 packages, approximately 5,000 pounds, of miscellaneous seeds were received by mail at the inspection house and after inspection forwarded to the consignees (not included in above table). There are also included in this table a few miscellaneous importations of seeds of small fruits.

Imported for immediate exportation (not included in above table):

Canada..... 340 pounds miscellaneous tree seeds.

Trinidad, British West Indies..... 900 pounds rubber seeds.

The distribution within the United States of the classes of nursery stock recorded in the above Tables 1, 2, 3, and 4 is indicated in Table 5.

TABLE 8.—*Distribution, by States, of bulbs, nursery stock, and seeds imported under regulation 3 of quarantine 37, during fiscal year ended June 30, 1925*

State	Bulbs (cases)	Stocks, cuttings, and scions (number)			Seeds (pounds)				
		Fruit	Rose	Nut	Fruit	Nut and palm	Orna- mental and tree	Rose	Total
Alabama.....	429	65,098					200		200
Arizona.....	79								
Arkansas.....	243								
California.....	6,317	627,287	25,300	36	1,161	45	1,283	1	2,490
Colorado.....	857		55,000				10		10
Connecticut.....	3,837	1,724,000	1,165,584		130	59	157	25	371
Delaware.....	405	30,000							
District of Columbia.....	893		500						
Florida.....	284				63,613	1,005	35		64,653
Georgia.....	1,333	47,000			17		1,151	36	1,204
Idaho.....	40								
Illinois.....	29,213	98,008	1,491,100		1	100	4,229	2	4,332
Indiana.....	2,080	835,000	366,000						
Iowa.....	2,230	4,401,600	237,500		2,266		984	3	3,253
Kansas.....	802	55,000			9,269		5		9,274
Kentucky.....	1,171						5		5
Louisiana.....	262					448	55		503
Maine.....	615								
Maryland.....	1,712	665,000	33,500						
Massachusetts.....	9,110	11,095	93,500			16	83	1	100
Michigan.....	5,989	768,731	115,000				61	21	82
Minnesota.....	2,097		5,500		1		56		57
Mississippi.....	238	20							
Missouri.....	2,468	72,012	1,000		3,320	23	28		3,371
Montana.....	214						1		1
Nebraska.....	736		10,000						
Nevada.....	3								
New Hampshire.....	322		3,000				510		510
New Jersey.....	13,451	37,667	530,915		17	2,795	686	32	3,530
New Mexico.....	51								
New York.....	59,175	8,859,586	2,602,425	25,250	3,803	146	2,203		6,152
North Carolina.....	818	88,000			202		128		330
North Dakota.....	128								
Ohio.....	13,974	835,700	993,725	9,500	130	39	211	11	391
Oklahoma.....	356								
Oregon.....	1,313	163,500	20,000		1,040	7	6		1,053
Pennsylvania.....	23,224	421,600	440,375		6,120	640	28,632	105	35,497
Rhode Island.....	1,502	1,500					2		2
South Carolina.....	318		600			6			6
South Dakota.....	80	6,500	12,000						
Tennessee.....	1,430	219,000	40,000				27		27
Texas.....	1,304	43,000	2,000		2	144		1	147
Utah.....	302	30,000							
Vermont.....	363	6					10		10
Virginia.....	1,587				50	3			53
Washington.....	2,340	25,500	500		2,980		360	3	3,343
West Virginia.....	744								
Wisconsin.....	2,720		36,000						
Wyoming.....	36								
Exported by permit- tee.....	327		17,500			12			12
Destroyed by permit- tee.....		570,000							
Total.....	199,522	20,701,410	8,298,524	34,786	93,920	5,690	41,118	241	140,969
1923-24.....	188,271	1,727	1,061	17	46,953	28,958	27,053	1,306	104,270

¹ Cases.

The record of entry under special permits issued under the provisions of regulation 14 of Quarantine 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock and to meet other technical and educational needs is given in Table 9.

During the fiscal year, 1,235 such permits were issued, authorizing the entry of 9,517,913 plants and bulbs. During the year a total of 8,575,129

plants and bulbs was imported under 1,087 of these permits. A summary of permits issued during the entire period of the quarantine to date is given in Table 10. The number of varieties considered has now reached a total of 26,855, of which 25,105 have been approved for entry. In addition to the tables mentioned, there has been prepared a table (Table 11) showing the distribution of the imported special permit material by States.

TABLE 9.—*Special permit importations, fiscal year 1925, with combined totals for 1920, 1921, 1922, 1923, 1924, and 1925*

Class of plant	Fiscal year 1925				Grand totals, 1920-1925			
	Permits issued		Permits imported		Permits issued		Permits imported	
	Number	Quantity	Number	Quantity	Number	Quantity	Number	Quantity
Gladiolus.....	123	2,487,320	105	1,576,359	769	37,325,692	587	23,718,244
Dahlia.....	73	7,337	59	3,794	342	29,615	269	18,997
Iris, rhizomatous.....	186	25,849	161	32,191	689	162,648	549	88,188
Iris, bulbous.....	173	3,906,115	148	4,513,188	590	21,246,034	405	14,444,603
Other bulbs, rhizomes, and roots.....	182	1,169,517	146	829,474	609	7,646,299	409	3,634,342
Peony.....	124	117,729	114	200,351	616	1,117,955	456	474,637
Rose.....	127	25,459	107	16,734	507	115,077	423	82,441
Orchids.....	171	27,414	168	23,446	587	104,095	490	74,768
Ornamentals.....	200	557,948	170	340,012	622	2,553,189	455	1,556,184
Herbaceous plants.....	187	1,193,049	163	1,039,374	624	4,058,880	456	2,361,388
Fruit trees and small fruits.....	4	176	2	206	41	6,109	17	904
Total.....	-----	9,517,913	-----	8,575,129	-----	74,365,593	-----	46,454,696

SUMMARY FOR YEARS 1920-1925

Fiscal year	Permits issued		Permits imported	
	Number	Quantity	Number	Quantity
1920.....	311	10,752,844	171	3,484,195
1921.....	622	13,965,013	411	8,132,634
1922.....	750	9,573,199	518	3,344,026
1923.....	897	15,175,003	719	10,357,406
1924.....	1,107	15,381,621	862	12,561,306
1925.....	1,235	9,517,913	1,087	8,575,129
Total.....	4,922	74,365,593	3,768	46,454,696

TABLE 10.—*Special permit material: Number of different varieties of plants requested and approved for fiscal years 1920-1925*

Class of plant	Re- quested	Ap- proved	Per cent ap- proved	Class of plant	Re- quested	Ap- proved	Per cent ap- proved
Gladiolus.....	1,006	887	88.2	Rose.....	2,571	2,224	86.5
Dahlia.....	2,291	2,166	94.5	Orchid.....	5,479	5,429	99.1
Iris, rhizomatous.....	1,785	1,698	95.1	Ornamentals.....	6,307	5,724	90.8
Iris, bulbous.....	364	363	99.7	Herbaceous plants.....	3,501	3,371	96.3
Other bulbs, rhizomes, and roots.....	1,853	1,743	94.1	Small fruits and fruit trees.....	155	142	91.6
Peony.....	1,543	1,358	88.0	Total.....	26,855	25,105	93.1

TABLE 11.—*Distribution of special permit material by States for fiscal years 1920-1925*

State	Gladiolus	Dahlia	Rhizo- matous iris	Bulbous iris	Peony	Rose	Orchid	Orna- mentals, etc.	Grand total
Alabama.....	14,985	0	0	15,980	0	174	0	0	31,139
Arizona.....	4	2	0	0	0	0	0	982	988
Arkansas.....	0	0	0	3,000	0	0	0	0	3,000
California.....	1,756,402	3,251	21,249	8,382,305	2,156	14,379	22,895	1,223,188	11,425,825
Colorado.....	14,652	0	0	20,990	0	0	607	5,170	41,419
Connecticut.....	500	571	805	125	54	30,891	0	56,674	89,620
Delaware.....	0	0	22	100	12	0	6	4,956	5,096
District of Co- lumbia.....	0	96	22	127	0	163	52	226	686
Florida.....	42,510	0	0	281,370	0	21	0	224,042	547,943
Georgia.....	5,000	12	0	88,910	0	0	0	510	94,432
Idaho.....	0	0	0	2,000	0	0	0	0	2,000
Illinois.....	3,139,963	33	9,390	691,015	29,537	2,564	448	203,824	4,076,774
Indiana.....	2,258,776	186	1,639	502,318	1,430	1,339	0	24,280	2,789,965
Iowa.....	38,235	0	0	0	21,378	0	0	12,174	71,787
Kansas.....	0	5	388	0	113	0	0	49	555
Kentucky.....	0	267	0	50,000	0	0	191	0	50,458
Louisiana.....	2,500	110	0	21,750	0	0	0	250	24,610
Maine.....	350	0	0	0	262	0	0	102	714
Maryland.....	23,057	249	77	101,000	18,085	0	100	1,453	144,021
Massachusetts.....	2,072,746	701	2,917	297,148	5,768	1,549	10,477	376,443	2,767,752
Michigan.....	11,591,735	2,519	2,409	475,798	56,035	265	56	414,070	12,542,887
Minnesota.....	81,231	44	865	0	1,681	160	315	33,784	118,080
Mississippi.....	6,500	0	9	49,776	0	0	0	27	56,312
Missouri.....	2,450	0	172	48,475	991	0	3,276	19,203	74,567
Montana.....	0	0	0	0	0	0	0	100	100
Nebraska.....	0	276	0	0	14	0	0	30	320
Nevada.....	0	0	0	0	0	0	0	0	0
New Hampshire.....	40,021	7	0	6,500	0	0	0	0	46,528
New Jersey.....	97,051	3,514	9,567	700,647	24,718	21,217	18,600	2,113,011	2,988,325
New Mexico.....	0	0	0	0	0	0	0	0	0
New York.....	1,674,552	2,252	19,419	874,593	147,875	2,892	12,070	1,911,906	4,645,559
North Carolina.....	3,975	0	0	31,990	0	0	0	24	35,989
North Dakota.....	0	0	0	0	7	0	0	0	7
Ohio.....	444,813	1,353	10,762	17,940	106,387	2,387	127	563,138	1,146,907
Oklahoma.....	510	0	0	8,000	0	0	0	198	8,708
Oregon.....	35,321	727	1,023	144,606	625	543	0	25,939	209,084
Pennsylvania.....	291,373	1,356	2,424	122,338	47,515	1,601	4,487	217,952	689,046
Rhode Island.....	654	1,031	1,551	58,190	2,209	313	47	17,413	61,408
South Carolina.....	0	0	0	10,000	0	0	0	0	10,000
South Dakota.....	0	0	11	0	2,410	587	0	84	3,092
Tennessee.....	0	116	361	118,766	222	0	0	1,400	120,865
Texas.....	2,000	0	0	623,230	0	90	0	25,203	650,523
Utah.....	0	0	0	4,000	0	0	0	4,747	8,747
Vermont.....	2,664	0	0	0	2,245	0	0	145	5,054
Virginia.....	16,000	0	2	393,104	1,177	0	0	7,766	418,049
Washington.....	18,678	319	2,686	206,562	28	511	0	17,375	246,159
West Virginia.....	0	0	0	4,000	0	0	0	36	4,036
Wisconsin.....	39,033	0	421	107,950	1,703	495	1,014	44,944	195,560
Wyoming.....	0	0	0	0	0	0	0	0	0
Total.....	23,718,244	18,997	88,188	14,444,603	474,637	82,441	74,768	7,552,818	46,454,696

IMPORTATIONS OF COTTON AND COTTON PRODUCTS

Tables 12 to 15 indicate, respectively, the importations of cotton, cotton waste, bagging, cottonseed, seed cotton, and cottonseed products during the year. The actual number of bales of cotton, cotton waste, and bagging is indicated, but inasmuch as bales vary in size, they are referred to as running bales.

TABLE 12.—*Ginned cotton, by country of growth and port of entry, 1924-25 (running bales)*

Country	Balti- more	Boston	Buf- falo	Calex- ico	Charles- ton	El Paso	Gal- ves- ton	Hous- ton	New Or- leans	New- port	New York	Niag- ara Falls
Anglo-Egyptian												
Sudan											113	
Arabia											16	
Australia											2	
Brazil											16	
British West Indies											742	
China		5,000									3,774	
Dominican Re- public											680	
Dutch East In- dies		49									2,228	
Ecuador		2									1,838	
Egypt		111,472									20,697	
Haiti											4,144	
India		13,436									19,789	
Mexico				70,886		3,611					24,135	
Nicaragua											13	
Paraguay											31	
Peru		2,880									84,508	
Porto Rico											1,749	
Salvador											7	
Syria											1	
United States (continental)	163	1,988	192		80		3	5	158	2,028	5,916	164
Virgin Islands (United States)											40	
Unknown		65									52	
Total	163	134,892	192	170,886	80	3,611	3	5	158	2,028	170,491	164

Country	Og- dens- burg	Phila- del- phia	Port Hu- ron	Port- land	Rich- ford	Rouses Point	St. Albans	San Fran- cisco	Seattle	Vance- boro	Yu- ma	Total
Anglo-Egyptian												113
Sudan												16
Arabia												2
Australia												16
Brazil												742
British West In- dies												32,679
China				1,653				18,813	3,439			680
Dominican Re- public												2,277
Dutch East In- dies												1,840
Ecuador												132,169
Egypt												4,144
Haiti												34,175
India				50				900				98,769
Mexico								126			11	13
Nicaragua												31
Paraguay												87,388
Peru												1,749
Porto Rico												7
Salvador												1
Syria												
United States (continental)	11	34	1		29	96	60			477		11,405
Virgin Islands (United States)												40
Unknown												117
Total	11	34	1	1,703	29	96	60	19,839	3,439	477	11	2408,373

¹ Includes 124 bales of unginned cotton from the Imperial Valley, Lower California, Mexico.

² Includes 2,195 bales of linters.

TABLE 13.—*Cotton waste by country of origin and port of entry 1924-25 (running bales)*

Country	Baltimore	Boston	Charleston	New Orleans	New York	Norfolk	Philadelphia	Richford	Rouses Point	St. Albans	San Francisco	Savannah	Seattle	Total
Belgium.....		23		102	974		274							1,373
Brazil.....		57			18									75
Canada.....	39	1,556			258			146	3	776				2,778
Ceylon.....					22		22							44
China.....		364			44						739		180	1,327
Cuba.....					123									123
Czechoslovakia.....							38							38
England.....	448	10,946	1,958	137	6,047	53	4,856					500		24,945
France.....		782			1,128		687							2,597
Germany.....		677			700		548							1,925
Holland.....		5,913	100		1,386		2,235							9,637
India.....		110			4,977		3,805							8,392
Italy.....		160			3,673		2,151							5,984
Japan.....		406			1,251		150				4,266		8,240	14,313
Malta.....					29									29
Mexico.....					119									119
Scotland.....					238		18							256
Spain.....					74		27							101
Switzerland.....		2,405			545		1,241							4,191
Venezuela.....					6									6
Unknown.....					1									1
Total.....	487	23,399	2,058	239	21,613	53	15,555	146	3	776	5,005	500	8,420	78,254

TABLE 14.—*Bagging by country of origin and port of entry, 1924-25 (running bales)*

Country	Baltimore	Boston	Charleston	Detroit	Houston	New Orleans	New York	Norfolk	Philadelphia	Port Huron	St. Albans	San Francisco	Savannah	Seattle	Total
Argentina.....			1				94								95
Australia.....												216			216
Belgium.....	1,278	426	577			456	7,245	511	1,170			5	459		12,127
Brazil.....							35								35
Canada.....		173		747		675	652	100	7	1,145	363				3,862
Cuba.....						88	15								103
Denmark.....							1,971		78						2,049
Egypt.....		38					5,124								5,162
England.....	3,095	3,340	2,279		304	8,377	11,614	9,869	6,311				2,225		42,414
France.....	97	45				1,040	8,146	32	2,874				110		12,344
Germany.....	53	243	849			591	7,933	106	2,243				256		12,274
Holland.....	677	959	738			1,221	15,649	1,127	1,962				1,321		23,654
India.....							192								192
Ireland.....	154						549		95						798
Italy.....					349	35	1,607								1,991
Japan.....							551					4,844		539	6,384
Latvia.....			450				29								29
Lithuania.....							5								5
Malta.....							21								21
Mexico.....							500								500
Norway.....							353								353
Scotland.....	985	284				194	5,222	288	2,224						9,197
Spain.....						936	2,901		52						3,889
Sweden.....	569						400		222						1,191
Switzerland.....		241	351			171	419	359							1,541
Wales.....	102						103								205
Total.....	7,010	5,750	5,244	747	653	8,784	71,330	12,392	17,238	1,145	363	5,065	4,371	539	140,631

¹ This includes 8,745 bales of rags restricted because of cotton contamination.

TABLE 15.—*Cottonseed, seed cotton, and cottonseed products 1924-25 (tons)*

Port	Cotton- seed	Seed cotton	Cotton- seed cake	Cotton- seed meal
Boston.....				425
Calixico.....	1 36, 775	1 256		
Eagle Pass.....			2, 479	
Seattle.....			75	
Yuma.....		1 24		
Total.....	36, 775	280	2, 554	425

¹ From the Imperial Valley, Lower California, Mexico. There are no restrictions on the entry of cotton-seed and seed cotton from that locality.

IMPORTATIONS OF FRUITS AND VEGETABLES UNDER QUARANTINE NO. 56

Tables 16 and 17 indicate, respectively, the fruits and vegetables imported during the fiscal year by countries of origin and by ports of entry.

TABLE 16.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by countries of origin*

[QUARANTINE 56 UNLESS OTHERWISE DESIGNATED]

Kind	Country and quantity	Total
Apricots.....pounds.....	Argentina, 1,313; Chile, 2,103.....	3, 421
Arrowroot.....do.....	Japan, 1,500.....	1, 500
Artichokes.....do.....	Chile, 100; France, 755.....	855
Asparagus.....do.....	Argentina, 22,025; Mexico, 17.....	22, 042
Avocados.....do.....	Colombia (Santa Marta district), 22,510; Cuba, 4,036,240; Dominican Republic, 3,250; Haiti, 1,680.....	4, 063, 680
Avocados (seeds removed).....do.....	Mexico, 28,124.....	28, 124
Ayales (Crescentia sp.).....do.....	Mexico, 737.....	737
Bananas.....bunches.....	Brazil, 1,022; Canal Zone, 838,840; Colombia, 2,822,000; Costa Rica, 4,139,818; Cuba, 3,028,256; Dominican Republic, 516; Guatemala, 5,994,970; Honduras, 14,170,435; British Honduras, 435,381; Jamaica, 10,579,106; Mexico, 3,519,397; Nicaragua, 3,085,504; Panama, 3,388,757.....	52, 004, 002
Beans (green):		
Faba.....pounds.....	Bermuda, 118,491 (prohibited importation after May 5, 1925).....	118, 491
Lima.....do.....	Argentina, 90; Bermuda, 2,660; Cuba, 1,328,760; Mexico, 60.....	1, 331, 570
String.....do.....	Cuba, 1,910; Mexico, 61,676.....	63, 586
Beets.....do.....	Bermuda, 673,735; Mexico, 154,260.....	827, 995
Burdock.....do.....	Japan, 5,334.....	5, 334
Cabbage.....do.....	Germany, 20,000; Holland, 793,826; Mexico, 28,278.....	842, 104
Cacao bean pods.....do.....	Trinidad, British West Indies, 650; Venezuela, 50.....	700
Cactus leaves.....do.....	Mexico, 400.....	400
Carrots.....do.....	Bermuda, 2,190,550; Mexico, 271,258.....	2, 461, 808
Cassaba.....do.....	China, 2,600; Cuba, 302,303; Dominican Republic, 840.....	305, 743
Cauliflower.....do.....	Mexico, 9,094.....	9, 094
Celery.....do.....	Bermuda, 1,312,598; Germany, 100; Mexico, 632.....	1, 313, 330
Chayotes.....do.....	Cuba, 9,763; Dominican Republic, 1,239; Mexico, 1,392.....	12, 394
Cherries:		
Fresh.....do.....	Argentina, 35,297; Chile, 268.....	35, 565
Dried.....do.....	Chile, 72,040; Italy, 79,650; Rumania, 2,159.....	153, 849
Cipolline.....do.....	Italy, 2,547,146.....	2, 547, 146
Citrus medica.....packages.....	Palestine, 593.....	593
Crosnes.....pounds.....	Belgium, 1,920.....	1, 920
Cucumbers.....do.....	Bermuda, 286; Cuba, 169,715; Mexico, 161,400.....	331, 401
Dashens (includes colocasia, caladium, inhames, malangas, and taro), pounds.....	Azores, 355,392; China, 666,098; Cuba, 133,770; Dominican Republic, 403,214; Japan, 345,218; Mexico, 8.....	1, 903, 700
Eggplants.....pounds.....	Argentina, 245; Bahamas, 8,670; Cuba, 2,767,468; Mexico, 148,952.....	2, 925, 335
Endives.....do.....	Belgium, 1,062,785; France, 12,281.....	1, 075, 066
Fennel.....do.....	Bermuda, 2,721; Italy, 11,433.....	14, 154
Garbanzos.....do.....	Mexico, 130.....	130
Garlic.....do.....	Azores, 216; Chile, 1,327,524; China, 115,826; Cuba, 500; Egypt, 17,558; France, 20,000; Italy, 2,405,448; Mexico, 1,373,197; Spain, 116,283; Turkey, 265.....	5, 376, 817
Ginger (crude).....do.....	China, 455,768; Cuba, 800; Dominican Republic, 2,558; Japan, 600; Philippines, 200; Sierra Leone, 45,815.....	505, 741

TABLE 16.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by countries of origin—Continued*

Kind	Country and quantity	Total
Grapes:		
Fresh (not hothouse). pounds..	Argentina, 2,192,107; Belgium, 32,657; Chile, 390,361; France, 189; Italy, 447,330; Mexico, 2,595.	3,065,239
Hothouse.....do.....	Belgium, 245,817.	245,817
Processed, sulphured, or fermented, barrels.	Italy, 10,397.	10,397
Waste.....pounds..	Italy, 60,000.	60,000
Grapefruit.....do.....	Cuba, 15,620,710; Jamaica, 20,230; Trinidad, British West Indies, 2,800.	15,643,740
Horseradish.....do.....	Germany, 2,252,358.	2,252,358
Husk-tomatoes.....do.....	Mexico, 25,523.	26,523
Kale.....do.....	Bermuda, 643,459.	643,459
Kohlrabi.....do.....	Bermuda, 1,030; Mexico, 291.	1,321
Kudzu.....do.....	China, 142,126.	142,126
Leeks.....do.....	Bermuda, 260; Cuba, 75.	335
Lemons.....crates..	Cuba, 20; Dominica, British West Indies, 1,259; Dominican Republic, 2; Italy, 1,308,119; Mexico, 10; Spain, 30.	1,309,440
Lettuce.....pounds..	Bermuda, 128,565; Mexico, 406,628.	535,193
Lily bulbs (edible).....do.....	China, 43,510; Japan, 40.	43,550
Limes (sour).....do.....	Dominica, British West Indies, 3,687,675; Dominican Republic, 9,150; Jamaica, 116,608; Martinique, French West Indies, 22,200; Mexico, 1,244,888; St. Kitts, British West Indies, 21,675; St. Lucia, British West Indies, 142,250.	5,243,946
Mangoes.....do.....	Argentina, 889.	889
Melons.....do.....	Argentina, 529,303; Azores, 3; Chile, 294,730; Cuba, 420; Dominican Republic, 88; Italy, 110,201; Mexico, 3,551,038; Spain, 81,712.	4,567,495
Mint.....do.....	Bermuda, 4,910; Mexico, 3,520.	8,430
Mustard.....do.....	Bermuda, 668; Mexico, 14,856.	15,524
Narcissus bulbs (edible).....do.....	China, 300.	300
Nectarines.....do.....	Argentina, 2,537; Belgium, 95.	2,632
Okra.....do.....	Cuba, 292,938; Mexico, 318.	293,256
Onions.....do.....	Antigua, 76,600; Argentina, 18,344; Australia, 946,357; Azores, 797; Belgium, 18,920; Bermuda, 771,636; Chile, 4,880,476; China, 470; Cuba, 95,830; Denmark, 430; Egypt, 45,842,309; Germany, 98,256; Holland, 49,280; Italy, 541,064; Japan, 5,000; Mexico, 1,307,132; Peru, 22,097; Portugal, 1,296; Spain, 65,425,068; Virgin Islands, 1,865.	120,103,227
Oranges:		
Under quarantine 56.....do.....	Argentina, 25,620; Cuba, 60,900; Dominican Republic, 1,256; Jamaica, 17,640.	105,416
Bitter (Q.56).....do.....	Spain, 35,000 (prohibited importation after May 5, 1925).	35,000
Mandarin (Q.28).....do.....	Japan, 1,640,664.	1,640,664
Pachyrhizus.....do.....	China, 57,162; Mexico, 4.	57,166
Parsley.....do.....	Bermuda, 1,095,042; Mexico, 15,315.	1,110,357
Peaches.....do.....	Argentina, 84,026; Belgium, 212; Chile, 10,174.	94,412
Pears.....do.....	Argentina, 18,264; Chile, 86,244.	104,508
Peas.....do.....	Bermuda, 20; Cuba, 2,984; Mexico, 3,328,488.	3,331,492
Peppers.....do.....	Cuba, 6,337,798; Dominican Republic, 762; Mexico, 4,102,266.	10,440,826
Pineapples.....crates..	Azores, 11; Bahamas, 1,324; Costa Rica, 70,752; Cuba, 1,621,773; Dominican Republic, 4; Guatemala, 16; Haiti, 3; Honduras, 792; Mexico, 46.	1,694,721
Plantains.....bunches..	Canal Zone, 4,000; Costa Rica, 5; Cuba, 164,951; Dominican Republic, 8,310; Honduras, 8,706; British Honduras, 53,430; Mexico, 469; Panama, 2,580.	242,451
Plums.....pounds..	Argentina, 68,932; Chile, 5,761.	74,693
Potatoes.....do.....	Bermuda, 3,556,688; Cuba, 505,495; Mexico, 2,075,213. (In accordance with potato regulations revised Feb. 28, 1922, as amended).	6,137,396
Prickly pears.....do.....	Mexico, 1,100.	1,100
Pumpkins.....do.....	Cuba, 16,400; Dominican Republic, 24,571; Mexico, 16,561.	57,532
Purslane.....do.....	Mexico, 816.	816
Radishes.....do.....	Mexico, 25,354.	25,354
Sage.....do.....	Bermuda, 70.	70
Shallots.....do.....	Belgium, 950; France 5,690.	6,640
Sorrel.....do.....	Bermuda, 1,052.	1,052
Spinach.....do.....	Mexico, 96,796.	96,796
Squash.....do.....	Cuba, 333,034; Dominican Republic, 165; Mexico, 57,169.	390,368
Strawberries.....do.....	Mexico, 444.	444
Swiss chard.....do.....	Bermuda, 75.	75
Tamarind bean pods.....do.....	Antigua, 32,413; Dominica, B. W. I., 4,487; St. Kitts, B. W. I., 14,575.	51,475
Tangerines.....do.....	Argentina, 149,170; Cuba, 4,550.	153,720
Tomatoes.....do.....	Bahamas, 4,910,377; Chile, 2,000; Cuba, 5,157,856; England, 960; Mexico, 61,303,496.	71,374,689
Turnips.....do.....	Bermuda, 18,878; Mexico, 122,775.	141,653

TABLE 16.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by countries of origin—Continued*

Kind	Country and quantity	Total
Vaccinium (cranberries, etc.).....	(Finland, 200 casks; Sweden, 43 barrels, and 125 pounds.)	casks..... 200 barrels..... 43 pounds..... 125
Water chestnuts..... pounds..	China, 1,619,839; Japan, 50.....	1,619,889
Water cress..... do.....	Mexico, 1,817.....	1,817
Water-lily roots..... do.....	China, 256,074; Cuba, 1,708.....	257,782
Watermelons..... do.....	Cuba, 143,642; Curacao, D. W. I., 2,640; Mexico, 1,169,576.	1,315,858
Entered for immediate export (not included in above):		
Ayales (<i>Crescentia</i> sp.).....		
pounds.....	Mexico, 175.....	175
Bananas..... bunches.....	Mexico, 800.....	800
Cassaba..... pounds.....	Cuba, 800.....	800
Cipolline..... do.....	Italy, 3,050.....	3,050
Dasheens (include colocasia, caladium, inhames, malangas, and taro), pounds.....	China, 600.....	600
Garlic..... pounds.....	Chile, 8,000; China, 300; Italy, 32,665; Spain, 187,642.....	228,607
Ginger..... do.....	China, 7,048.....	7,048
Grape fruit..... do.....	Bahamas, 34,440; Cuba, 293,806; Jamaica, 2,735,980.....	3,064,226
Kudzu..... do.....	China, 610.....	610
Lemons..... crates.....	Italy, 133,955.....	133,955
Lily bulbs (edible)..... pounds.....	China, 150.....	150
Onions..... do.....	Australia, 723,173; Belgium, 48,000; Chile, 18,500; Egypt, 10,590,492; Spain, 934,590.....	12,314,755
Oranges..... do.....	Jamaica, 74,270.....	74,270
Pineapples..... crates.....	Cuba, 17,764; Guatemala, 3; Jamaica, 3; Mexico, 17; Straits Settlements, 1,000.....	18,787
Tomatoes..... pounds.....	Mexico, 4,196,360.....	4,196,360
Water chestnuts..... do.....	China, 707.....	707
Water-lily roots..... do.....	China, 795.....	795

TABLE 17.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by ports of entry*

[Quarantine 56 unless otherwise designated]

Kind	Port and quantity	Total
Apricots..... pounds.....	New York, 3,421.....	3,421
Arrow root..... do.....	Seattle, 1,500.....	1,500
Artichokes..... do.....	New York, 855.....	855
Asparagus..... do.....	Douglas, 2; El Paso, 13; New York, 22,025; Nogales, 2.....	22,042
Avocados..... do.....	Key West, 476,480; New Orleans, 1,323,840; New York, 1,488,720; Tampa, 774,640.....	4,063,680
Avocados, (seeds removed)..... do.....	Eagle Pass, 1,644; El Paso, 1,337; Laredo, 25,143.....	28,124
Ayales (<i>Crescentia</i> sp.)..... do.....	El Paso, 75; Nogales, 662.....	737
Bananas..... bunches.....	Baltimore, 2,924,079; Boston, 3,195,657; Eagle Pass, 30; El Paso, 18,970; Galveston, 865,900; Houston, 1,240; Key West, 21,062; Laredo, 8,222; Los Angeles, 219,798; Miami, 71,943; Mobile, 2,474,618; New Orleans, 21,436,303; New York, 15,935,128; Nogales, 19,973; Philadelphia, 4,650,629; San Francisco, 113,197; San Pedro, 3,200; Tampa, 44,053.....	52,004,002
Beans (green):		
Faba..... pounds.....	New York, 118,491.....	118,491
Lima..... do.....	Key West, 31,491; New Orleans, 5,285; New York, 1,294,734; Nogales, 60.....	1,331,570
String..... do.....	Calexico, 27; Douglas, 1,789; Eagle Pass, 639; El Paso, 24,466; Key West, 125; Laredo, 6,537; New Orleans, 945; New York, 840; Nogales, 28,218.....	63,586
Beets..... do.....	Calexico, 132; Douglas, 5,247; Eagle Pass, 1,698; El Paso, 131,211; New York, 673,735; Nogales, 15,972.....	827,995
Burdock..... do.....	Seattle, 5,334.....	5,334
Cabbage..... do.....	Brownsville, 40; Calexico, 296; Douglas, 1,463; Eagle Pass, 105; Laredo, 2,665; New York, 813,826; Nogales, 23,709.....	842,104
Cacao-bean pods..... do.....	New York, 700.....	700
Cactus leaves..... do.....	San Diego, 400.....	400
Carrots..... do.....	Calexico, 1,104; Douglas, 5,151; Eagle Pass, 548; El Paso, 246,956; Laredo, 140; New York, 2,190,550; Nogales, 17,359.....	2,461,808
Cassaba..... do.....	Chicago, 2,600; Key West, 48,864; New York, 214,600; Tampa, 39,679.....	305,743
Cauliflower..... do.....	Douglas, 76; Nogales, 9,024.....	9,094
Celery..... do.....	Calexico, 26; Douglas, 218; New York, 1,312,698; Nogales, 388.....	1,313,330

TABLE 17.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by ports of entry—Continued*

Kind	Port and quantity	Total
Chayotes.....pounds..	El Paso, 700; Laredo, 630; New Orleans, 8,703; New York, 1,544; Nogales, 57; Tampa, 760.	12, 394
Cherries:		
Fresh.....do.....	New York, 35,565	35, 565
Dried.....do.....	New York, 145,031; Philadelphia, 8,818	153, 849
Cipolline.....do.....	Boston, 254,234; Los Angeles, 12,600; New York, 2,280,312	2, 547, 146
Citrus medica.....packages	Chicago, 35; New York, 144; Seattle, 10; Washington, 404	593
Crosnes.....pounds.....	New York, 1,920	1, 920
Cucumbers.....do.....	Douglas, 485; El Paso, 80; Key West, 5,428; Laredo, 56,253; New York, 164,573; Nogales, 104,582	331, 401
Dasheens (includes colocasia, caladium, inhames, malanges, and taro).....pounds..	Boston, 12,508; Chicago, 6,800; Key West, 46,833; Los Angeles, 24,586; Milwaukee, 480; New York, 571,460; Nogales, 8; Philadelphia, 206; Portland, Oreg., 11,000; Providence, 339,803; San Francisco, 655,362; Seattle, 189,257; Tampa, 45,397	1, 903, 700
Eggplants.....do.....	Douglas, 143; Key West, 115,486; Los Angeles, 350; New Orleans, 71,185; New York, 2,589,712; Nogales, 148,459	2, 925, 335
Endives.....do.....	New York, 1,075,066	1, 075, 066
Fennel.....do.....	Boston, 11,433; New York, 2,721	14, 154
Garbanzos.....do.....	Douglas, 109; Nogales, 21	130
Garlic.....do.....	Boston, 190,841; Brownsville, 66,500; Calexico, 25; Douglas, 5,434; Eagle Pass, 7,808; El Paso, 41,250; Laredo, 849,320; Los Angeles, 650; New Orleans, 158,036; New York, 3,937,396; Nogales, 2,315; Providence, 216; San Francisco, 117,026	5, 376, 817
Ginger (crude).....do.....	Boston, 53,715; Chicago, 4,900; Los Angeles, 11,300; Milwaukee, 240; New York, 110,725; Philadelphia, 1,062; San Francisco, 288,738; Seattle, 35,060	505, 741
Grapes:		
Fresh (not hothouse).....do.....	Ajo, 58; Boston, 32,500; Eagle Pass, 1,702; El Paso, 496; Laredo, 20; New York, 3,030,144; Nogales, 319	3, 065, 239
Hothouse.....do.....	New Orleans, 20; New York, 245,797	245, 817
Processed, sulphured, or fermented.....barrels	Boston, 921; New York, 9,476	10, 397
Waste.....pounds.....	New York, 60,000	60, 000
Grapefruit.....do.....	Boston, 17,080; Chicago, 1,074,780; New York, 14, 183, 680; St. Louis, 368,200	15, 643, 740
Horseradish.....do.....	Boston, 34,757; New York, 2,130,767; Philadelphia, 86,834	2, 252, 358
Husk-tomatoes.....do.....	Eagle Pass, 6; El Paso, 26,517	26, 523
Kale.....do.....	New York, 643,459	643, 459
Kohlrabi.....do.....	Eagle Pass, 3; Laredo, 250; New York, 1,030; Nogales, 38	1, 321
Kudzu.....do.....	Boston, 4,000; Los Angeles, 15,100; New York, 44,550; Philadelphia, 418; San Francisco, 66,910; Seattle, 11,148	142, 126
Leeks.....do.....	New York, 335	335
Lemons.....crates.....	Boston, 20,893; Eagle Pass, 1; New Orleans, 196,476; New York, 1,090,515; Nogales, 9; Philadelphia, 1,546	1, 309, 440
Lettuce.....pounds.....	Calexico, 11; Douglas, 4,438; Eagle Pass, 699; El Paso, 26,273; Laredo, 100; New York, 128,565; Nogales, 375,107	535, 193
Lily bulbs (edible).....do.....	Boston, 3,230; Chicago, 1,760; Los Angeles, 178; New York, 14,690; San Francisco, 20,810; Seattle, 2,882	43, 550
Limes (sour).....do.....	Brownsville, 7,620; Eagle Pass, 27,284; El Paso, 27,420; Laredo, 1,043,206; Los Angeles, 43,359; New Orleans, 89,833; New York, 3,909,705; Nogales, 8,399; San Francisco, 82,100	5, 243, 946
Mangoes.....do.....	New York, 889	889
Melons.....do.....	Brownsville, 167; Douglas, 186; El Paso, 205; New York, 1,016,454; Nogales, 3,550,480; Providence, 3	4, 567, 495
Mint.....do.....	Douglas, 33; Eagle Pass, 9; El Paso, 3,476; New York 4,910	8, 430
Mustard.....do.....	Calexico, 4,280; Douglas, 2,706; El Paso, 1,428; New York, 668; Nogales, 6,442	15, 524
Narcissus bulbs (edible).....do.....	San Francisco, 300	300
Nectarines.....do.....	New York, 2,632	2, 632
Okra.....do.....	Eagle Pass, 3; El Paso, 105; Key West, 26,700; New Orleans, 98,015; New York, 165,243; Nogales, 210; Tampa, 2,980	293, 256
Onions.....do.....	Baltimore, 28,000; Boston, 21,679,986; Brownsville, 21,275; Calexico, 5,155; Del Rio, 900; Douglas, 11,075; Eagle Pass, 279; El Paso, 251,877; Laredo, 195,426; New York, 96,040,365; Nogales, 715,710; Philadelphia, 129,584; Portland, Me., 69,160; Providence, 2,093; San Francisco, 743,510; Seattle, 200,466; Tacoma, 8,141; Tampa, 225	120, 103, 227
Oranges:		
Under Quarantine 56.....do.....	Boston, 7,490; Chicago, 42,280; New York, 55,646	105, 416
Bitter (Q. 56).....do.....	New York, 35,000	35, 000
Mandarin (Q. 23).....do.....	Seattle, 1,640,664	1, 640, 664
Pachyrhizus.....do.....	Boston, 200; Nogales, 4; San Francisco, 56,962	57, 166
Parsley.....do.....	Calexico, 108; Douglas, 195; El Paso, 14,695; Laredo, 55; New York, 1,095,042; Nogales, 262	1, 110, 357
Peaches.....do.....	New York, 94,412	94, 412

TABLE 17.—*Fruits and vegetables imported during fiscal year ended June 30, 1925, by ports of entry—Continued*

Kind		Port and quantity	Total
Pears.....	pounds	New York, 104,508.....	104,508
Peas.....	do.	Calexico, 8; Douglas, 1,034; Eagle Pass, 210; El Paso, 1,371; Laredo, 770; New York, 3,004; Nogales, 3,325,095.	3,331,492
Peppers.....	do.	Ajo, 241; Brownsville, 200; Calexico, 110; Del Rio, 6,884; Douglas, 6,061; Eagle Pass, 83,682; El Paso, 595,756; Key West, 601,174; Laredo, 106,578; Los Angeles, 60; New Orleans, 22,805; New York, 5,714,581; Nogales, 3,302,694.	10,440,826
Pineapples.....	crates	Boston, 17,056; Chicago, 5; Key West, 1,055,464; Laredo, 1; Los Angeles, 16; Miami, 593; New Orleans, 38,644; New York, 576,135; Nogales, 45; Philadelphia, 500; Providence, 7; Tampa, 6,255.	1,694,721
Plantains.....	bunches	Boston, 5; Key West, 43,777; Miami, 5,589; New Orleans, 48,761; New York, 17,983; Nogales, 21; Tampa, 126,315.	242,451
Plums.....	pounds	New York, 74,693.....	74,693
Potatoes.....	do.	New York, 3,556,688 (under Quar. 56); Douglas, 1,766,965; El Paso, 11,708; Key West, 24,000; New York, 481,495; Nogales, 296,540 (in accordance with potato regulations, revised Feb. 28, 1922, as amended.)	6,137,396
Prickly pears.....	do.	El Paso, 630; Laredo, 470.....	1,100
Pumpkins.....	do.	Brownsville, 620; Eagle Pass, 3,722; El Paso, 460; Key West, 9,250; Laredo, 9,525; New York, 26,756; Nogales, 2,234; Tampa, 4,965.	57,532
Purslane.....	do.	Douglas, 305; El Paso, 75; Nogales, 436.....	816
Radishes.....	do.	Calexico, 522; Douglas, 1,144; Eagle Pass, 242; El Paso, 15,279; Nogales, 8,167.	25,354
Sage.....	do.	New York, 70.....	70
Shallots.....	do.	New York, 6,640.....	6,640
Sorrel.....	do.	New York, 1,052.....	1,052
Spinach.....	do.	Calexico, 1,311; Douglas, 6,513; Eagle Pass, 334; El Paso, 62,901; Nogales, 25,737.	96,796
Squash.....	do.	Ajo, 1,106; Brownsville, 48; Calexico, 335; Douglas, 1,952; El Paso, 30,188; Key West, 640; Laredo, 340; New York, 332,559; Nogales, 23,200.	390,368
Strawberries.....	do.	El Paso, 20; Laredo, 322; Nogales, 102.....	444
Swiss chard.....	do.	New York, 75.....	75
Tamarind-bean pods.....	do.	New York, 51,475.....	51,475
Tangerines.....	do.	New York, 153,720.....	153,720
Tomatoes.....	do.	Boston, 94,542; Brownsville, 22,806; Calexico, 295; Del Rio, 1,638; Douglas, 3,784; Eagle Pass, 46,257; El Paso, 287,160; Key West, 1,215,997; Laredo, 1,065,789; Los Angeles, 675,952; Miami, 1,372,818; New Orleans, 1,245,200; New York, 6,220,423; Nogales, 58,076,935; San Diego, 33,726; San Francisco, 1,009,462; Tampa, 1,905.	71,374,689
Turnips.....	do.	Ajo, 375; Calexico, 277; Douglas, 3,495; Eagle Pass, 227; El Paso, 107,125; New York, 18,878; Nogales, 11,276.	141,653
Vaccinium (cranberries, etc.).....	do.	New York, 200 casks; San Francisco, 43 barrels, and 125 pounds.	
Water chestnuts.....	pounds	Boston, 54,400; Chicago, 69,650; Milwaukee, 15,000; Los Angeles, 3,400; New York, 686,330; Philadelphia, 4,620; San Francisco, 597,739; Seattle, 183,750.	1,619,889
Water cress.....	do.	Douglas, 654; Eagle Pass, 135; Nogales, 1,028.....	1,817
Water-lily roots.....	do.	Boston, 2,672; Chicago, 2,720; New York, 14,761; San Francisco, 204,795; Seattle, 32,834.	257,782
Watermelons.....	do.	Ajo, 75; Brownsville, 185,895; Douglas, 156; El Paso, 25; Key West, 88,116; New Orleans, 5,000; New York, 53,166; Nogales, 983,425.	1,315,858
Imported for immediate export:			
Ayales (<i>Crescentia</i> sp.).....	pounds	Nogales, 175.....	175
Bananas.....	bunches	Nogales, 800.....	800
Cassaba.....	pounds	New York, 800.....	800
Cipolline.....	do.	New York, 3,050.....	3,050
Dasheens (includes, colocasia, caladium, inhames, malangas, and taro).....	pounds	Seattle, 600.....	600
Garlic.....	do.	New York, 228,607.....	228,607
Ginger.....	do.	San Francisco, 6,948; Seattle, 100.....	7,048
Grapefruit.....	do.	Key West, 246,400; New York, 2,817,826.....	3,064,226
Kudzu.....	do.	San Francisco, 410; Seattle, 200.....	610
Lemons.....	crates	Boston, 8,125; New York, 125,830.....	133,955
Lily bulbs (edible).....	pounds	Boston, 150.....	150
Onions.....	do.	Boston, 5,495,540; New York, 6,096,042; San Francisco, 723,173.	12,314,755
Oranges.....	do.	New York, 74,270.....	74,270
Pineapples.....	crates	Los Angeles, 3; New York, 18,767; Nogales, 17.....	18,787
Tomatoes.....	pounds	Nogales, 4,196,360.....	4,196,360
Water chestnuts.....	do.	San Francisco, 307; Seattle, 400.....	707
Water-lily roots.....	do.	San Francisco, 795.....	795

IMPORTATIONS OF BROOMS AND BROOM-CORN

During the fiscal year 1925 there was a decided falling off in the importation of brooms and broomcorn, as compared with the fiscal years 1922 and 1923. Table 18 indicates the quantities of each imported and the countries of origin.

TABLE 18.—*Importations of brooms and broomcorn, 1924-25*

Country	Brooms	Broomcorn
Hungary.....		189 bales. 1 package.
Italy.....	1,022 bales..... 92 cases..... 2 packages.....	131 bales.
Roumania.....	9 cases..... 4 packages.....	
Uruguay.....	4 cases.....	
United States.....		84 bales.
Total.....	1,022 bales..... 105 cases..... 6 packages.....	404 bales. 1 package.

IMPORTATIONS OF OTHER RESTRICTED PLANT PRODUCTS

In addition to the foregoing record of plants and plant products, the board has supervised the importation under Quarantine No. 55 of 801,742 pounds of seed or paddy rice from Mexico, imported through the port of Nogales.

Entries under Quarantine No. 39 (on account of the flag-smut and take-all diseases) were as follows: 32 bags of wheat at New York, and 112 pounds at San Francisco; 110 pounds of seed oats were landed at New York and immediately exported; 7 sacks of barley arrived at New York, 4 of which were exported; 3 bags of rye were imported at New York; 2 importations of bran were made at San Francisco, 1 in amount of 200,040 pounds and another totaling 5,091 bags.

Under Quarantine No. 42 (against Indian corn or maize from Mexico) 198 bags of corn were entered at San Francisco; 374 bags entered Naco and shipped in bond through the United States to Mexico; 9 bags of seed corn were permitted entry at Laredo, under special safeguards.

TERMINAL INSPECTION OF MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS

During the fiscal year 1925 the terminal inspection points for the inspection of mail shipments of plants and plant products in the States of Georgia, Mississippi, Oregon and California were revised.

In view of the very slight risk from insect pests and plant diseases attending shipments of such succulent plants as tomatoes, eggplants peppers, cabbages etc., at the request of the proper officials of the States of Arkansas, Florida, Georgia, Idaho, Montana, and Oregon and of the District of Columbia, the postmasters concerned were advised that plants of this class, addressed to places in the States and District named, are exempt from terminal inspection.

To reduce to the utmost the possibility of spread of plant pests with mail shipments of plants and plant products, at the suggestion of the Federal Horticultural Board the postmasters in the States maintaining terminal inspection were advised that plants and plant products shipped under the certificate of the Federal Horticultural Board are no longer exempt from terminal inspection, but shall be sent to the nearest inspection point for inspection in the manner prescribed in section 486 of the Postal Laws and Regulations of 1924.

California, Arizona, Montana, Florida, Washington, Arkansas, the District of Columbia, Mississippi, the Territory of Hawaii, Utah, Oregon, Georgia, and Idaho, in the order named, have availed themselves of the provisions of the terminal inspection act of March 4, 1915. This inspection, which is conducted entirely at the expense of the States concerned, in addition to the protection which it gives to these States, is of great value to the board in the enforcement of its domestic quarantines.

CONVICTIONS FOR VIOLATIONS OF THE PLANT QUARANTINE ACT

The solicitor of the department reported during the year 32 convictions for violations of the plant quarantine act. All but one of these had relation to the white pine blister rust

quarantines, the other to the avocado or alligator pear quarantine. Fines aggregating \$800 and costs were imposed.

NEW AND REVISED PLANT QUARANTINES AND OTHER RESTRICTIVE ORDERS

The following quarantines and other restrictive orders have been either promulgated or revised during the fiscal year:

DOMESTIC QUARANTINES

The pink bollworm quarantine, amended August 26, 1924, to permit interstate movement of cottonseed, lint, and linters from Eddy and Chaves Counties, N. Mex.; the Japanese beetle quarantine, revised March 21, 1925 extending the regulated area and materially modifying the restrictions on the movement of farm products; the European corn borer quarantine, amended December 12, 1924, to include additional infested area; the satin moth quarantine, amended September 13, 1924, to include additional infested

area; and the fruit and vegetable quarantine of Porto Rico, promulgated May 27, 1925.

FOREIGN QUARANTINES

The nursery stock, plant, and seed quarantine amended November 20, 1924, eliminating the requirement of certification of freedom from earth, and January 10, 1925, making provision for safeguarding the entry of plant products admitted without permit; and the fruit and vegetable quarantine, amended January 10, 1925, to provide for safeguarding the entry of cured or processed fruits and vegetables, and February 6, 1925, to provide for certain exceptions authorizing greater freedom of entry of fruits and vegetables.

OTHER RESTRICTIVE ORDERS

Regulations governing the importation of cotton and cotton wrappings into the United States, amended December 8, 1924, providing for the entry of cotton from certain border districts of Mexico.

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